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Infinite Energy

Cold Fusion and New Energy Technology

Published by Cold Fusion Technology, Inc. Vol.3, No.17, 1997-1998

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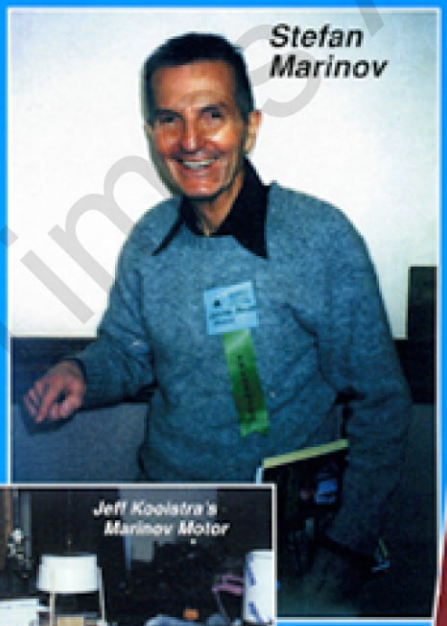
Dr. Randell Mills and Hydrino POWER...and Stefan Marinov's *Theory-Defying* Motor

Dr. Randell L. Mills



Stefan Marinov

Heretical Verities
by Thomas Phipps, Jr.

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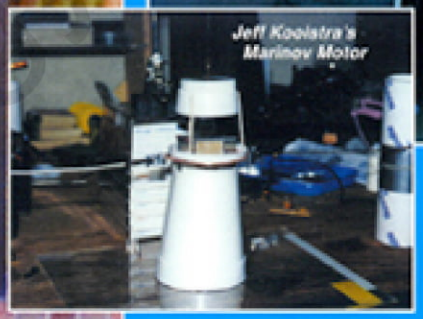

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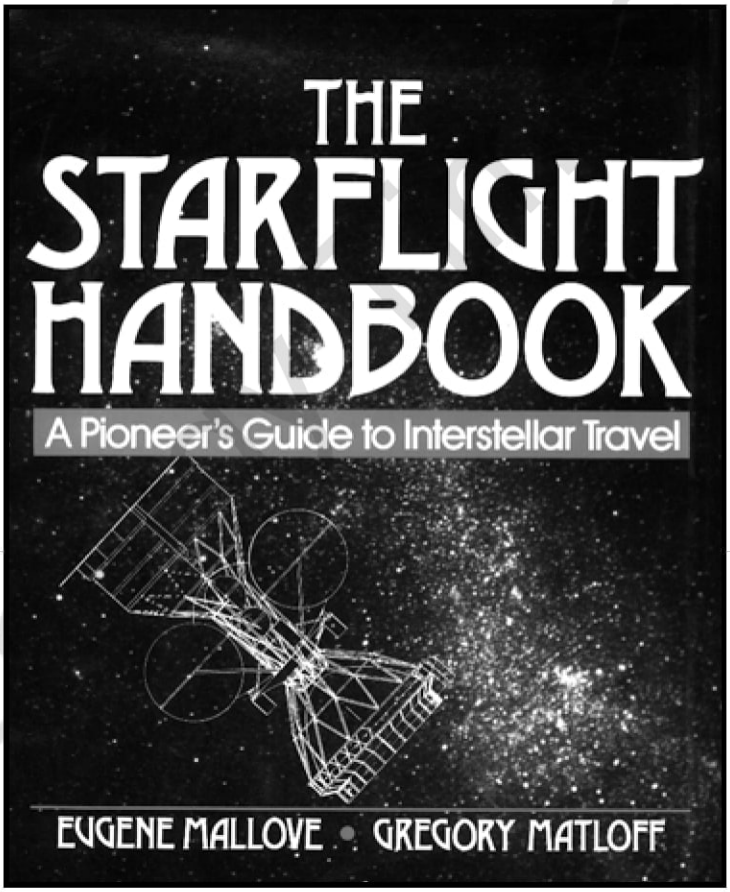
Ad Astra per Aspera!



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Dr. Randell Mills at BlackLight Power, Inc.
(Courtesy, Art Rosenblum)

(Right)
Dr. Stefan Marinov.
(Photo, 1996, by Gene Mallove)

(Center)
Marinov Motor Confirms New Physics with Simple Experiment
(Photo, courtesy, Jeffery Kooistra)

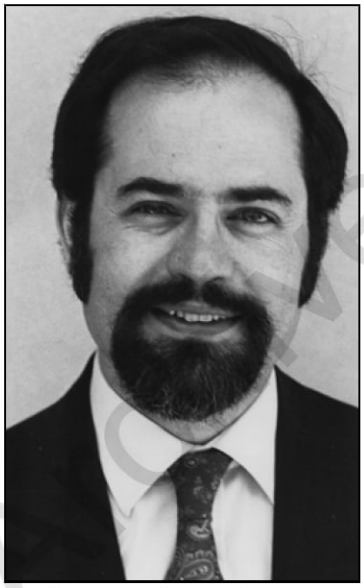
(Right)
Heretical Verities Book and its author Dr. Thomas E. Phipps, Jr.
(Photo, Courtesy Dr. Phipps)

(Bottom)
New Cold Fusion and Transmutation Book in Japan by Dr. T. Mizuno
(Photo, Courtesy Dr. Mizuno)

(Left Bottom)
1997 Asti, Italy Cold Fusion Conference Group Photo
(Courtesy William Collis)

New Energy Times Archive

By Eugene F. Mallove, Sc.D.



New Physics, Life Saving, and Philanthropy

Today, some 25,000 children will die of disease and deprivation, simply because they do not have what we in the developed world take for granted each day—clean drinking water. It is literally a matter of life or death whether this world has enough energy and good faith to make pure water available to children who will die without it.

We draw your attention to the contributed essay/proposal, "Hopes and Dreams" on page 9, by cold fusion scientist Dr. Dennis Cravens. Dennis speaks of the need for philanthropic support of projects to help save lives—*some immediately, and more in the near term*—using both available, proven technology and the emerging commercial cold fusion devices that will soon be with us. Now that very robust performance is being demonstrated with a variety of technologies, *we can do it!*

None of these new energy technologies would work, however, if it were not for the astonishing discoveries in physics that have emerged from the "energy from water" and electromagnetics fields. This issue of *Infinite Energy* is especially pregnant with evidence—both scientific and commercial—that the self-satisfied "End of Science" and "Theory of Everything" mentality so prevalent in mainstream scientific culture is about to be dealt a much deserved death blow.

We have low-energy transmutation phenomena that are being researched, replicated, and technologically positioned to help clean-up the radioactive mess that the nuclear bomb culture and business-as-usual conventional nuclear physics and engineering have made in the 20th Century. We have electrical energy coming —seemingly from space itself —in the remarkable experiments of the Correas, which have staggering commercial potential.

We have Dr. Randell Mills of BlackLight Power, Inc., whose experimental and astrophysical evidence for hydrinos—shrunken hydrogen atom electron states— appears to rewrite quantum mechanics (QM). Many in mainstream cold fusion —yes, Virginia, there *is* a heavy-water/palladium and heavy-element-transmutation-rejecting "cold fusion establishment,"shocking though that may be. It resists even *looking* at Mills' ideas.

The longer these people ignore the experimental evidence provided by Mills, the more unseemly their behavior becomes. Let's face it guys: hydrinos either exist or they do not. There is much astrophysical and laboratory evidence for them. There is also much reason to believe that standard QM has little chance (OK, maybe a small one) of explaining the plethora of nuclear anomalies and energy anomalies in "cold fusion." So be it, if this requires going beyond the admittedly highly successful QM and seeing whether a larger theory—such as that of Mills, or of anyone else—can deal with these anomalies. We have seen the Dr. Hagelsteins and the Drs. Chubbs, the Dr. Preparatas and Kims, and many others try to employ old physics tools to explain what is going on—they have not succeeded. Perhaps Mills has. We only wish that he would be more open to the increasingly well-characterized anomalies of low-energy transmutation, which his hydrino theory seems to allow perfectly—see the language in his Autralia-granted patent, which is reproduced in full (pages 67-72). If the catalytically shrunken hydrogen atom is neutral-looking enough it could well sneak into positively-charged nuclei and raise the havoc that is being seen.

Why am I so ready to chuck standard QM for what Mills and others might offer? Well, just look at standard electromagnetics—standard physics is not very solid! Sure, it specifies and long ago predicted our entire radio-television-cell-phone communications culture. That's great, but *so what!* It can't, apparently, explain the Marinov motor—as Dr. Thomas Phipps, Jr. and Jeffery Kooistra dramatically show in this issue. A simple table-top experiment that high-school students can perform may blast standard EM theory out of the water as a comprehensive physical framework—and along with it what may be left of Al Einstein. Yes, read *Heretical Verities*, and read Kooistra's review of it. Dr. Thomas Phipps is only one—the most eloquent one—of a growing number of perceptive experiment-driven theorists who find much to fault within Special Relativity—the physics icon of the 20th century, if ever there was one. Good bye, Al, nice having known ya'!

Now back to philanthropy and investing. Does anyone seriously doubt the need for that key catalytic ingredient—not potassium, but money—to transform this world: to save the dying children who need a mere glass of clean water each day to be rescued; to overturn the physics and sheep-like media establishments who buy their Theory of Everything, Give-Us-a-Few-Tens-of-Billion-Dollars-to-prove-it BS? Many of the cold fusion/new energy companies are beginning to receive much deserved funding and investment to keep *them* from dying of starvation or dehydration. Great! But much more is needed, Very soon—like NOW— we are at the stage where engineers can rapidly bring these discoveries into the marketplace so that we CAN save those children. But who will *buy* the new energy devices to GIVE to the children and elders of this world? Philanthropists, that's who.

We are fortunate to have met a few of these *wonderful* people ourselves. Some have an orientation around investing in new energy companies—but feel that it is a Good Deed—even if by some chance they should lose. Fine! Others simply want to help support the field with donations, and they have. For example, several key people gave financial resources to keep *Infinite Energy* going and make it go further. We are not ashamed to say that we could use more. We've worked for years with either NO salaries, or our current very modest ones. We are prepared to continue in the trenches as low-paid guerrillas. But think of how much more effective we and our colleagues would be if we could afford, for example, those $23,000-a-shot Op-Ed-page ads in the *New York Times* that Mobil Oil runs. Mobil is so rich that it *donates* its ad space to other causes! Do you think they'd give us space to tell the story of how the cold fusion /new energy field is going to put them, Shell, Texaco, Saddam Hussein, and the rest of them out of business? Hah!

How about money to print 25,000 or more copies of *Infinite Energy* each time (rather than the current 5,000) and have a *permanent touring exhibit* with working new energy devices that would go from technical trade show to trade show —*giving away* introductory copies so that we can prove to the critically need engineers and scientists that we are *not kidding*—this stuff IS real!

Continued on page 5

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We have recently moved to a better office facility—a much *warmer* office in the same complex—thanks to the insulation and better air circulation. Our new and indispensible Managing Editor, Barbara A.F. DelloRusso started here beginning in the first week of January. This was a remarkable innovation for us! You mean, we will actually have at least *two* people always in the office processing orders, and answering phones, preparing the magazine, and doing experiments—not just *one* (me) for two thirds of the week, as in the past!! The day of the one-person magazine office is over, thank you!

We still are holding onto our key laboratory space— and magazine storage space— in the adjacent building. These things are much cheaper than Tokamaks. Hell, our entire annual budget right now—is less than the salary of the highest paid MIT staffer—hot fusioneer Prof. Ronald Parker. Parker, you may remember, called Pons' and Fleischmann's work a "scam" back in 1989, barely a month after the Utah announcement—and then he bold-facedly denied he had planted such a revolutionary charge.

Sure, we need lots of the things we've just mentioned and more— so please help us, if you can, or if you know someone better able who might be persuaded to help. So many other environmentally conscious organizations receive *millions* of dollars each year, e.g. the Union of Concerned Scientists in Cambridge, Massachusetts—budget over $4 million/year. But are they looking into cold fusion as they should be? Of course not! We *gave* the UCS our materials on cold fusion. They threw it into the trash basket. As soon as we are accepted, the UCS will be history—including Prof. Henry Kendall of MIT— its guiding force, the Nobel laureate and heir to a vast medical products fortune. He is a travesty, possessing (so far as we can tell) not the intellectual curiosity of a snail, like so many of his MIT Physics Department brethren.

Not satisfied with some of the plans given above, we have in mind even grander goals. One nearly miraculous group (maybe its work *is* "miraculous") that we have contacted (per agreement, it shall remain anonymous *forever*) has agreed to put up so much money for Cold Fusion and New Energy that we could literally BUY the US hot fusion program (if we were so stupid as to want to do that!) and make it to GO AWAY. These people are real, with deep roots in American history: they are quiet, peace-minded, and I have met them face-to-face. They have the spirit, that is for sure. They want to do it. We know that they really *can* do it, but *will* they do it? We *pray* they will, but we have been used to disappointments!

Of course, we would not waste time with evaporating hot fusion if this blessed money really did materialize in the coming year. But we *would* set up a Tinsley/Schwinger Foundation *immediately* to channel tens of millions of dollars into grants to worthy scientists and engineers who want to work on New Energy Technologies—several hundred such scientists each year for years to come. Emphasis would be on developing the science and technology that would most likely lead to short term-implementation of demonstration units and devices that could be used to provide clean water in remote areas. Saving lives, you bet. Do you think that *Nature* and *Science* would accept our full-page ads— $6,000 to $7,000 announcements about the availability and application procedures for these grants?

And, we would set up a *New Energy Institute* NERI, proabably right here in Live Free or Die (Cold Fusion or Death!) New Hampshire, within commuting distance for *good* scientists from the Massachusetts area, but NOT giving the state of Mass. anything to boast about. Let it have the reputations of Harvard and MIT professors to boast about forever—these Federally funded folk were the snooty-nosed ones who ignored and

Continued on page 51

Institute for New Energy

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LETTERS TO THE EDITOR

Guys,

Issue #15-16 was a blockbuster, I have enjoyed it more than I can express. What is happening with the pulsed abnormal gas discharge device of the Correas? [See *IE* issues #7, 8, and 9}

Warner Frith
Little Rock, Arkansas

Glad we knocked some blocks off! The Correas are working diligently toward commercialization of their technology. We'll have news of this whenever we have something substantial that we can tell our readers. Note well that "absence of evidence [of visible commercialization] is NOT evidence of absence"—that no commercial preparations are taking place! Furthermore, look at the lovely technical article, formerly secret, that the Correas have allowed us to publish in this issue.—EFM

• — • — •

I just received yet another excellent double issue. I hate to tell you that instead of curing, it aggravated my insomnia. I could not put the issue down because there was so much excitement in it.

S. Pal Asija
Shelton, Connecticut

• — • — •

Thank you for selling so many copies of *Newton versus Einstein.* I like to think that this is because Chris Tinsley wrote the first review of the book and you published it in the August 1994 issue of "COLD FUSION" [Ed. Note: The magazine Dr. Mallove, Chris Tinsley and Jed Rothwell formerly edited for its three only issues, before the WGI publisher went under due to problems unrelated to the magazine.] I met Chris in Neal's laboratory at Oxford University. We had a most enjoyable day talking about this and that and the other, not to mention the stimulation of an English pub lunch. What impressed us was Chris's scientific curiosity and his balanced skepticism.

In the review Tinsley argues that theories are nothing but models not to be taken too seriously. I like his words: "... it (the theory) should never be the banner borne aloft in a crusade." He made a scientific contribution to Newtonian physics, there and then, when he said: "... I see the Faraday disk as a clear demonstration of both Ampere forces, and the wrongness of relativistic electrodynamics." This had not been obvious to me before I read the review. We will miss you Chris, and so will the readers of *INFINITE ENERGY.*

Newton versus Einstein has now been reviewed in seven countries and four languages (English, French, Spanish, and Polish). Enclosed is a copy of the twelfth and last review which just recently appeared in *FOUNDATIONS OF PHYSICS* (Vol.27, No.10, 1997). It may be of interest to you and your readers.

Peter Graneau
Concord, Massachusetts

• — • — •

A man of action... subscriber John McClaughry of the Ethan Allen Institute in Vermont sent this copy of a letter...

December 15, 1997

Judy Cresanta
Nevada Policy Research Institute
PO Box 20312
Reno NV 89515

Dear Judy:

I'm writing to pass on to you an issue which ought to become a front burner issue in Nevada. Nevadans are outraged that Yucca Mountain has been selected for the Federal government's permanent nuclear waste repository. What if a way were found to remediate (end the radioactivity) of spent nuclear fuel right at the site of the reactors? Then there wouldn't be any shipping of waste around the country, and no need for the Yucca Mountain depository.

Just such a process seems to have been discovered by two research groups, one in Cincinnati and one in Sarasota. The process is in its infancy, but as a onetime scientist, the data looks convincing to me, especially in view of the reversed isotopic ratio in the copper produced in the Cincinnati experiment. Unfortunately the science establishment has branded the process "impossible," which invariably happens when experimental data threaten to make somebody's government-funded line of work obsolete.

I would encourage you to contact Dr. Robert W. Bass, a Nevada resident with strong credentials (see p. I9) about, at the very least, an article in *Nevada Journal.* I do not know Dr. Bass, but I do know the editor of *Infinite Energy*, Dr. Eugene Mallove, and have had him as a speaker at an EAI (Ethan Allen Institute) dinner meeting.

Yours truly,
John McClaughry,President
Ethan Allen Institute
Concord, Vermont

• — • — •

I send you a check renewing the subscription to *Infinite Energy* and for one video "Free Energy: The Race to Zero Point." Congratulations, and PLEASE, no more double issues: four months waiting is too much for any fan of *Infinite Energy.*

Norberto Meyer
Republic of Argentina

Thank you! We intend to have single issues from now on, now that Managing Editor Barbara A.F. DelloRusso has joined us to help with our tremendous workload and to keep us on track. You may notice that the present issue is thicker than usual—96 pages in all. We packed in lots of extra material, such as the monumental Mills patent and interview. It is more like a "1.5-size" issue. A lot of extra value, but it's yours at no additional cost. Issue #18 will be sent out in late March 1998—just before ICCF7. Those who show up at ICCF7 in Vancouver (April 19-24) will get a free copy. —EFM

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Addendum to his article in *Infinite Energy* in Issue #15 & #16, pp.112 from Dr. Harold Aspden (Received 12/15/97)

In my article entitled "Supergravitons and Cold Fusion" that was published at pp. 112-116 in the double issue #15 & #16 of *Infinite Energy* for July-November 1997, I referred to the antigravity research of Professor Laithwaite of the Imperial College in London, England. Later, several years after his retirement, Laithwaite became involved in research at the University of Sussex, closer to his retirement venue.

I regret having now to report that the U.K. newspaper: *The Times* (Thursday, December 4, 1997, page 25) contained the obituary of Professor Eric Laithwaite, who died on November 27, aged 76.

Having followed his research with interest and visited him a while ago to discuss his findings and witness his demonstration of the loss of weight of a 50 lb. flywheel that he lifted effortlessly. I thought I should draw your attention to some comments that were included in his obituary.

The obituary reminds us that, as a recipient of many crank letters when he was Professor of Electrical Engineering at the Imperial College in London, there was: "One which caught his eye: in it an amateur inventor described a wheeled device which apparently contravened Newton's Third Law of Motion—it moved without any power to the wheels or any thrust. Intrigued, Laithwaite invited the inventor, Alex Jones, to Imperial College. The device Jones brought was a simple gyroscope and it moved forward on Laithwaite's bench with ease. "Alex showed me something I could not explain, so I just had to investigate it. It was sheer curiosity ...."

The obituary goes on to explain then how Laithwaite's efforts to show the weight loss of the gyroscopic devices he built were met with "utter hostility." "He retired from Imperial College in 1981 pretty much in disgrace." "But he never lost his fascination for gyroscopes." "None of my critics could ever explain to me how a 50 lb spinning wheel loses weight," he said. He teamed up with Bill Dawson, a fellow electrical engineer and businessman and spent the last years of his life experimenting with a variety of complex gyroscopic rigs, finally proving to his satisfaction that they could produce "mass transfer"—a brand of new thrustless propulsion system. In 1993 he applied for a patent on a gyroscopic spacedrive. In September 1996, however, two NASA scientists arrived a this Sussex University laboratory, and his life went full circle. They were looking for a new way of getting spacecraft into earth orbit, and headed straight for the world expert. "I showed them all the magic of magnetic levitation," said Laithwaite happily, "and they gave me a contract." He was working on Maglifter when he collapsed.

The obituary published in *The Times* is quite lengthy. Its opening paragraph adds a little more detail to the latter project: "At the age of 76, at a time when many emeritus professors have long since hung up their gowns, Eric Laithwaite was happily working, like a schoolboy with a Meccanoset, on the biggest project of his life—a huge working model of a futuristic rocket launcher. America's National Aeronautics and Space Administration had commissioned him to develop a concept worthy of Ian Fleming's Dr. No—a five-mile long track to be tunnelled up the inside of a 10,000 ft mountain, hurtling a space capsule through the summit into Earth orbit. The power was not to come from conventional rockets but from the love of Laithwaite's life—linear motors."

Readers of this message who are interested in anomalous levitation phenomena will feel added sadness to hear that this great pioneer, Eric Laithwaite, has passed away. No doubt NASA will pursue that project regardless of this loss. For my part as a remote observer, I am reminded of my own brief meetings with Alex Jones and with Eric Laithwaite and am more than curious about that comment about "mass transfer." I recall that Laithwaite told me of research funding received from Prince Charles and used to build a machine involving gyroscopic devices set in two adjacent compartments. These were to be screened from one another in a physical sense, but arranged to allow the transfer through the physical screen of something associated with the spin of one gyroscopic device that could be detected by its effect on the other device. Here, my mind was on the possibility of the aether developing its own spin and being shed as a kind of "thunderball" which could be moved through the wall separating those two compartments. If that machine, when eventually built and tested, did in fact exhibit such a phenomenon, then one can but be curious and wish to know more.

As to that loss of weight by the 50 lb flywheel I also recall the time when Professor Salter of Edinburgh University, an expert of gyroscopes, was offered funding by British Aerospace to stage demonstrations testing devices that purport to lose weight, but the event, though planned, was cancelled. Laithwaite, I heard, had refused to go to Scotland to prove something that could be demonstrated so easily in his own university base in the South of England. All one needed to see was Laithwaite standing on a large weighing machine and doing his flywheel lift while one read the weight recorded. It was only years later that a television documentary on Laithwaite's gyroscopic activity, which included participation by Alex Jones, was screened here in the U.K. and it did include that weighing machine demonstration which proved the weight loss.

It is a sad coincidence that my *Infinite Energy* account referring to Professor Laithwaite's research was published in November 1997, the very month in which he died. Though readers of *Infinite Energy* may not be interested in notions concerning antigravity they ought to be curious about the idea that energy, in the form of something radiating from a spinning wheel, can be transferred through an intervening membrane and captured as part of the spin property of a spinning wheel on the other side of that membrane. If Laithwaite's apparatus did reveal that property experimentally, then we can begin to wonder about those 'two opposing magnets' in the Kovac account published on page 123 of that same issue of *Infinite Energy*. Aether in spin will set up a magnetic field. Two adjacent regions of aether spinning in opposite directions will replicate the action of two opposing magnets.

We are, therefore, presented with clue after clue by those who find anomalies in their experiments, the prime example being cold fusion, with its atomic transmutations and excess heat. We just need to decipher the evidence. That I try to do in my own way and such interest as I have in these matter is merged with my own pursuits that I am recording on my own Web pages on Internet at **<http://www.energyscience.co.uk>.**

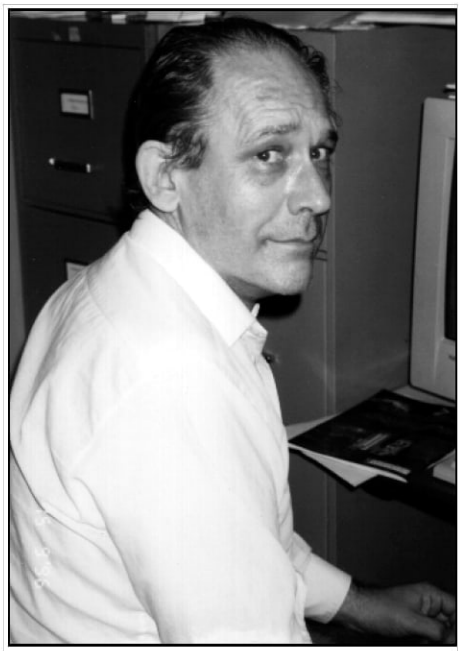
I regret that I cannot add more to this note about Professor Laithwaite. He was one of the very few professors of standing in the U.K. who has dared to challenge orthodox opinion on the basics that apply to the energy field. Gravitation and electromagnetics are as close as one can get to energy in a world intent on avoiding unnecessary pollution. Let us hope that what we read in *Infinite Energy* will inspire more professors to follow Laithwaite's example.

I conclude by drawing attention to the fact that my Internet web page address as noted on p. 116 of my *Infinite Energy* article on "Supergravitons and Cold Fusion" has been changed to that now given above.

Dr. Harold Aspden
haspden@iee.org
England

This is a very fine contribution by Dr. Aspden . Yes, we too had learned earlier from The Times of Laithwaite's death. This tragedy reminds us also of our recently departed colleague Chris Tinsley's efforts in 1994 to replicate the levitating effects that were seen in the gyroscopic device displayed by Professor Laithwaite on the BBC program series, Heretics. Chris actually built a three-gyro device that remains mysterious even to this day. Insufficient resources were engaged to test it. Perhaps we shall return to this area in a future issue of Infinite Energy. As many readers know, there are many, many claims— and even patents—regarding "reactionless thrust-

www.IEEAF.org/Infinite Energy



The late Christopher P. Tinsley at the *Infinite Energy* office in New Hampshire in September, 1996.
Photo by Gene Mallove

ers," antigravity devices, and the like. We remain open to the inherent new physics possibilities. We know for a fact that a top engineer at the Boeing Corporation takes this matter VERY seriously and has planned testing of one of the more significant claimed "reactionless thruster" devices. ***—EFM***

• — • — •

Dear Dr. Mallove,

Thank you for your interest in my (and colleagues') research and for sending the magazines containing our joint article with Dr. Vakarin about protonic conductors. [See *IE* Issue #12 "Cold Fusion and Protonic Conductors"—EFM]

As regards to "The Saint," please find here also the letter of A. Zastyrets, Editor-In-Chief of the Journal *Nauka Urala* ("Science of the Urals") to you. This Journal has published in May a sufficient large article concerned with progress in cold fusion study in Russia and other countries. This publication contains also my answers to some questions by the Editor, among other, regarding to results of ICCF-6, to cold fusion study in ceramics, to the present state of these investigations in my group. During conversation with Mr Zastyrets, I have shown your letter with materials regarding to *The Saint* movie, which I have received from you simultaneously. He has taken an interest in *The Saint*. As a result, this article was supplemented with a movie review by A. Zastyrets, however our conversation was not intended to be distributed so widely. Its letter reproduces the sense of this part of the publication concerning *The Saint*.

Its Journal desires, as I understand, to cooperate with *Infinite Energy*. Could you please, send to the Editor-In Chief of *Nauka Urala* directly later your magazine, some summaries from *IE*, your recommendations, etc. to make a pertinent publication. It would be of value to familiarize [him] with the materials, showing the current situation In this scientific field.

I continue to work on implications which have attracted your interest. Thank you, and best regards,

A. Samgin
Ekaterinburg, Russia
June 23, 1997

<u>The letter from A. Zastyrets:</u>

Dear Dr. Mallov!

Perhaps "Nauka Urala" isn't that very edition, where you could expect to find a reference to the film "Saint." But I doubt whether the scientific contents of this film will be considered in any specialized Russian magazine (devoted to cinema).

I am sure you'll find this reference an unflattering one. Trying to be fair I have to recognize the "Saint" a work of art of poor quality, it may be merely lost in the ocean of Hollywood's production swept over Russian video market. On the other hand I highly appreciate your work as a scientific consultant.

It's a great pity that in a Russian version of a copy I succeeded to get, "cold fusion" is interpreted as ("guided thermonuclear reaction"). Undoubtedly

"управляемая термоядерная реакция"

this curious incident is an illustration of the fact that the thermonuclear idea is a monopolist one in our attempts to find a way out of the fuel and energy crises.

I liked very much your magazine *Infinite Energy*, but for many reasons we have no opportunity to take out a subscription for it. If it's possible we should like inserting summaries of some articles from *Infinite Energy* in our newspaper.

The problem of cold fusion is of great interest for Urals scientific community. Dr Samgin has made sure of it, having answered a lot of telephone calls after my publication "Cold, inspiring the soul..."

Sincerely yours,
Arcady Zastyrets, Editor in Chief

Indeed, we will (belatedly) send materials for the editor of <u>Nauka Urala</u>, even though it gets increasingly expensive for us to send free magazines to Editors in distant countries, who are in need of cold fusion information (but who may not be able to pay for their magazines). We do this as a matter of moral obligation. That is why <u>Infinite Energy</u> will use any contributions for such purposes that more financially able readers are able to provide.—EFM

• — • — •

To Whom it May Concern:

This check ($10.00) was given to us as a memorial donation after the passing of my brother-in-law, Bill Burns, in April. Finally, today I went through his belongings and found copies of your magazine with your address.

Bill was an aerospace engineer and one of the pioneers in the field of cryogenics. He really liked and supported your magazine and hoped it would be a successful venture.

Sincerely
Melody Burns
Fairacres, New Mexico

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Melody, we thank you for the check—even though there was some problem with the account being closed and we were charged by the bank more for the fine than the contribution! The thought is what counted. We always feel sad when one of our subscribers is no longer around to enjoy the progress that is being made. All Bills wishes will come true.—EFM

• — • — •

Dear Eugene Mallove:

Please accept our thanks for your participation in the League of Women Voters Education Fund's peer review process for the National Dialogue Information Package [on nuclear waste issues].

We sent the package (or parts of it) to 56 people, representing such varied perspectives as university researchers, public interest groups, Native American tribal members, local and state governments and Department of Energy resource specialists. In addition, participants in three of the four National Dialogue Pilot Field Workshops had an opportunity to comment on the materials. We received 33 responses from 22 reviewers and 11 workshop participants.

The comments we received were extremely helpful. For example, almost everyone agreed that the Technical

Continued on page 12

Infinite Energy Archive

Hopes and Dreams

by *Dr. Dennis C. Cravens*

The birth of cold fusion has been a long and complicated one. The time is rapidly approaching when the new chemically assisted nuclear events will be coming out of the laboratories and into the greater world of daily human needs. Just like a newborn child, this revolutionary technology has great potential: It can become what we want it to become. At this time we should begin to think about how the technology should be developed to best benefit mankind. Some people want to take the technology to make gold and money for themselves. Some hope to make large financial empires. Some will want to make weapons. Certainly, new corporations and individual wealth will be generated. However, I personally hope that some benevolent individuals will take the initiative to start the technology down the right road during its infancy. We need those who can see the needs of all of mankind and begin now to bend the technology to those goals.

The technology will begin to grow rapidly. Yes, it is a little wobbly now, but soon it will stand on its own. Some of us need to take it by the hand and teach it which path to travel upon. I want to teach it to make the world a better place. There will be much to be done and learned. I have thought long and hard about what I want of the new technology. I wish to teach it to supply the most fundamental and the most universally required thing for mankind **—clean water.** Let me explain, and perhaps someone will want to help me in my quest.

The Problem

According to the World Health Organization, unsafe water is the world's number one killer. **It is estimated that about 25,000 people each day are killed from complications due to unsafe water and about 80% of the world-wide sickness is due to such water**. Drinking and bathing water are the most common routes for the spread of infectious disease. For example, diarrhea alone causes four-million deaths each year worldwide. In India alone, 1.5 million children die of diarrhea each year. In some countries women and children spend up to six-hours each day simply fetching water and carrying it home. This greatly impairs such activities as education, income-generating work, and social progress. In some urban areas people must spend up to 25% of their income to purchase water from private wells and then carry it home on their heads.

Difficulties

There have been many efforts to supply water to such areas. Although it sounds like it would be easy and straightforward to construct simple water systems, it is not. About 75% of such projects result in long-term failure. Most systems are poorly designed and lack any long-term support. Most of these difficulties fail because of lack of local community involvement in the planning and construction, lack of health education systems, and long term planning for maintenance. Success rates rise to 95% when the local communities supply part of the cost and planning. Since there are many different conditions throughout the world, a single system cannot be optimized for all locations.

A Proposal

It is proposed that a long term project be initiated to develop an array of water system prototypes and place them in use in developing countries. It is proposed that funding, development, field tests, and maintenance be conducted over a ten-year period. The project would cost about one million U.S. dollars. About half of that would go for salary, design, testing, facility, overhead... etc. during the 10-year period. The other half would be used at about $50,000 per year on systems, construction, maintenance, travel, shipping, etc. for individual systems in the field. For the project to work, a long term commitment and total funding at the beginning are required.

About half the working time will be on production and design of water systems using existing technologies, such as solar cells. The other half of the time would be used to develop a compatible power device such as the Patterson Power cell or "cold fusion" systems for use in the water systems. The systems will be designed to make use of a range of power sources.

It is important to notice that the success of the project does not rest on the success of the more exotic power systems. Indeed, current technologies such as photovoltaics and water rams can be used in many applications. Such existing technologies will be used during the first few years until the young technologies have a proven success rate over longer periods. This is because it will take a while for the newly delivered technology to develop and stand on its own. For the first few years, other technologies may be needed to assist the fledgling technology until it can support itself.

Target areas

Areas such as Rwanda, India, and Bangladesh are in drastic need for such solutions. However, the initial work would concentrate on Central America and South America (such as Guatemala and Bolivia). The rationale is this: the initial system will need more support until proven. Areas such as Guatemala provide easier logistical support and shipping. Initial contact with missionary groups from the Church of Christ, Baptist Church, and the Catholic Relief agencies have promised support and local contacts. I am indebted to the Water Partners for most of my facts and approach to the problem The more remote and logistically-challenging areas will be tackled after individual systems have shown proven reliability.

Key to success

Local support is the primary key to long term success of such projects. Communities will be selected that will contribute to the construction and maintenance of the project. It is unlikely that a project will succeed long term unless the community itself contributes to the efforts. Quickly constructed, "freely given" systems have less than a 25% success rate in practice. Only by commitments of 10 years or more and local participation do such systems succeed. The design will be based on modular systems, and repair parts and maintenance will be available for the duration of the project.

Conclusion

Some people want their child to be a doctor to make money and live well. Some are happy to see their child be a doctor to help others and ease pain.

.....I hope that when cold fusion comes of age it will do many things. But if it did no more than give each person a glass of clean water, it would make the world a better place.

Prepared by:
Dennis Cravens
Box 1317
Cloudcroft, New Mexico 88317

(Gene Mallove encouraged Dennis to take time from his critically important experiments to write this.—Bless You, Dennis!)

New Energy Times Archive

New Energy Partners — PRESS RELEASE — January 19, 1998

NEW ENERGY PARTNERS,
Limited Partnership

8 Sound Shore Drive, Suite 100
Greenwich, Ct 06830
Phone: 203-629-4447
Fax: 203-629-4848
Contact: Daniel J. Cavicchio, Jr.
Phone: 203-629-4447

New Energy Partners, Limited Partnership (NEP) announced their first closing in December, 1997. Managed by Daniel J. Cavicchio, Jr., a resident of Greenwich, Connecticut, NEP is a venture capital firm that is investing in revolutionary new energy technologies.

"One of the first areas of priority, stated Mr. Cavicchio, are companies that have developed working prototypes of energy cells based on technologies that have formally been referred to as cold fusion. There has been a lot of controversy surrounding this technology since 1989 when two scientists, Drs. Fleischmann and Pons from the University of Utah, claimed that they had created a fusion reaction at room temperature in lab apparatus. Since that time a tremendous amount of research has taken place in the United States and around the world. This research has proven without a doubt that the energy effects that were claimed by the University of Utah scientists are real, even though their theory is much in dispute. Most researchers, some of whom have elaborate theories and models, now believe that the effect is due to some type of nuclear reaction, but not necessarily fusion. Theories relate to a slow fission reaction or some type of hydrogen energy in conjunction with certain metals.

"The theories may be important for the advancement of physics, but what is important to NEP is demonstrated proof that companies have devices that work—meaning these devices produce tremendous amounts of energy at low costs." Mr. Cavicchio states, "We have thoroughly investigated and invested in two companies since the fund has had its first closing. These companies have built devices that produce energy many, many times greater than what could be produced by burning fossil fuels or other chemical means. The devices work and are reproducible. Furthermore, they have attracted the attention of a number of major corporations which are in discussions with these companies regarding scale-up and commercialization of these devices.

"Over the past nine years this technology has been investigated intensively by a number of government research labs and other reputable institutions. Organizations such as SRI International, Los Alamos National Laboratories, National Aeronautics and Space Administration, the Electric Power Research Institute (EPRI), and the Naval Research Laboratory have investigated or replicated the effects that are now being commercialized by these companies. Positive results have been published in peer-reviewed articles and six international conferences have been held." Mr. Cavicchio states, "If it were not for all the negative publicity created by the premature announcement by the University of Utah, the wealth of information now available would clearly convince any reputable investigator that we are on the forefront of a new wave of energy technology. Fortunately, an increasing number of reputable scientists, engineers, and trend forecasting institutes are now backing these new technologies as the wave of the future." As an example Mr. Cavicchio mentions Gerald Celente, founder of the reputable Trends Forecasting Institute in Rhinebeck, New York, as having investigated and predicted that this will be "the biggest investment opportunity of the 21st Century." Celente, as reported in *USA Today*, also predicts a major public announcement in 1998 pertaining to this development.

The fund is still open to investors who meet the criteria of an "accredited investor," as defined by securities laws. For individual investors, they would need to have a net worth of at least $1 million or sustainable income of $200,000 per year.

Mr. Cavicchio founded the fund after his own extensive due-diligence convinced him that these new energy technologies have tremendous potential for the future of the world. All these technologies are environmentally benign as they do not involve the burning of fossil fuel or any of the by-products, such as carbon dioxide and other pollutants that are associated with fossil fuels.

Mr. Cavicchio received his Bachelor's Degree at Rensselaer Polytechnic Institute in 1966, where he graduated first in his class. He went on to The University of Michigan, receiving his two Masters Degrees and a Ph.D. in communication sciences and computer and communication sciences.

He started his career at the Aerospace Corporation, a government-funded "think tank," and then went on to join McKinsey & Co., in New York.

At McKinsey, he managed consulting assignments for technology-based companies, such as General Electric, AT&T, CBS, Occidental Petroleum, and Corning Glass. He then served as Director, Business Development, for American Can Company, where he was involved with new business and new product development in the packaging sector, and then later in the specialty retailing sector.

In 1984, he co-founded Greenwich Venture Partners, a buyout firm that specializes in turnarounds of technology-based companies. He was instrumental in acquiring and turning around a capacitor company, spun-off from Sprague Electric Company and a defense company specializing in remote detection spectrometers for chemical warfare and pollution detection.

NEP will also be evaluating and potentially investing in a variety of other new energy technologies. For example, there have been a number of claims and some demonstrations of devices using cavitation, electromagnetic devices, capacitor water discharge devices, etc. "We are committed to doing careful due diligence of all devices and technologies," Cavicchio states. "This field has had its fair share of charlatans who have given the field a bad name. However, there are real and effective devices out there and the companies developing these devices are looking for the right type of funding and management support. We will provide both.

"There is truly an infinite amount of energy available in the universe, but the only challenge is how to corral it in an effective way. Burning fossil fuel has been easy and the costs have been moderate. Alternative sources such as wind power or solar involve substantial capital costs and unreliable sources. The technologies we are looking at will prove to be reliable and low-cost from both a capital and fuel cost perspective. I predict that in the 21st Century, the cost of fuel will be no more a consideration for companies or countries than is the cost of their own water. I believe that the companies that NEP will invest in will be in the forefront of this technology and will lead the way for the benefit of all mankind as well as for the investors."

For further information, please contact Daniel J. Cavicchio, Jr,, 8 Sound Shore Drive, Suite 100, Greenwich, CT 06830; Telephone: 203-629-4447; Fax: 203-629-4848.

New Energy Times Archive

A *must read* book—Order your copy today from Cold Fusion Technology, Inc. !

Newton versus Einstein, by Peter Graneau and Neal Graneau. Carlton Press, 1993 Hardcover. 219 pages, $14.95. ISBN 0-8062-4514-X

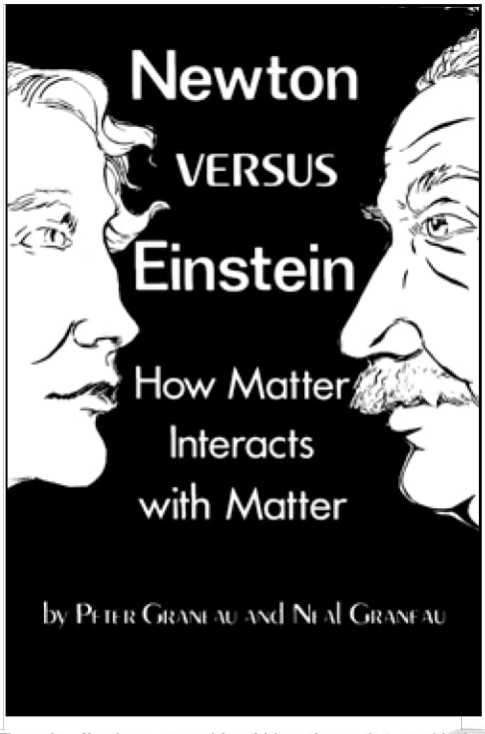
NEW TECHNOLOGY!

NEWTON versus EINSTEIN is not merely a critique of contemporary physics. Nor is it just an outline of the clash of philosophies. It points the way to new technologies from space accelerators to high-current switches and improved metal refining. Most exciting is the discovery of how to gain solar energy from ordinary water via the release of intermolecular bonding energy, as recently explained in *Infinite Energy* (Issue #10) and featured in a forthcoming BBC-TV program. It could become as important as the discovery of nuclear energy, yet be benign to man.

Praise for Newton versus Einstein

Inertia is a much-discussed topic. The Graneaus give a beautiful account in which they relate theories of inertia back to those of Mach at the beginning of the century. They view inertia as the result of the gravitational interaction of all particles in the universe on the body in question, instantaneous transfer making even distant galaxies a part of the interaction .

The authors feel, correctly, that there is a resemblance between the Academies of Science at present and the influence of the Church at the time of Galileo.



There is effective censorship of ideas inconsistent with the I926 Quantum Theory or which play down the significance of Relativity. If new observations do not agree with the present physics, the investigator is accused of fraud or sloppy science....

But now, the authors believe, the dust has settled and there are too many aspects of present physics that seem inconsistent with observation. The time has come for a Great Re-Think. There is a telling quotation from Einstein in a letter written towards the end of his life to his old friend Besso. It states that field concepts may be entirely wrong. If they are, Einstein says, then all his endeavors and the rest of modern physics are up for re-forming.

This little book is the expression of workers who really do try to penetrate into the darkness, instead of singing the old song in a new style. But scientists like the Graneaus will never win the Nobel Prize. They ask too many disturbing questions to obtain the support of the establishment scientists who decide who gets the Prize.

Professor John O'M. Bockris,
JOURNAL OF SCIENTIFIC EXPLORATION, Spring 1995

ABOUT THE AUTHORS

Peter Graneau is well known for a long series of experiments in classical electrodynamics performed during thirty-five years in university and industrial laboratories on both sides of the Atlantic. The results he obtained were consistent with the old Newtonian electrodynamics which flourished in Europe during the nineteenth century. Dr. Graneau has published his findings in more than forty papers in prestigious physics and engineering journals and in his 1985 book *Ampere-Neumann Electrodynamics of Metals*. Some of his work has been sponsored by the U.S. National Science Foundation, which commended him for his efforts. The Graneaus make their home in the town of Concord, Massachusetts. They love nature, and they walk and canoe where Henry David Thoreau lived. In this beautiful area, Peter Graneau has time to contemplate the course physics may take in the next century.

Neal Graneau was born in London, England, and attended Fenn School in Concord, Phillips Exeter Academy in New Hampshire, and Winchester College in England. He traveled with school theater and poetry groups, and played piano recitals. Neal Graneau studied physics at King's College of London University, and at Oxford University as a graduate student. He is currently a full-time researcher at Oxford. For ten years, he spent his summers in his father's MIT laboratory. There this father-and-son team researched, invented, built and performed the experiments described in this book. When not at work, Neal finds time to relax by playing the drums in an Oxford group.

Newton versus Einstein
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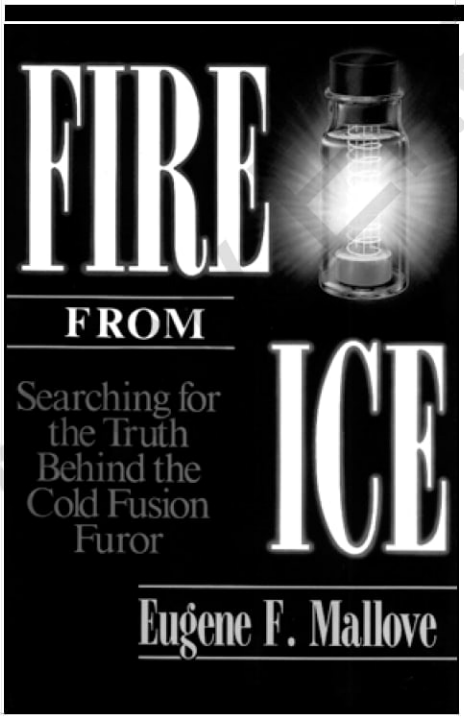

Read *The* Book on the Cold Fusion saga.....

Fire from Ice:

Searching for the Truth Behind the Cold Fusion Furor

By Eugene F. Mallove, Sc.D.
Published by John Wiley & Sons, Inc., 1991, 334 pp.

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—Arthur C. Clarke

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(Note: price is $29.95 for other foreign countries)

"Letters" — continued from p.8

The comments we received were extremely helpful. For example, almost everyone agreed that the Technical Component was useful, but that the language needed to be simplified and technical terms re-defined. Reviewers were divided on whether to include Civilian Radioactive Waste in the materials; most favored including it, but emphasized the need for detail to make the information understandable and useful. Many reviewers noted that the document omitted an explanation of the relative risks associated with wastes and safety measures needed for the various waste types. The review also prompted several technical questions, which we are in the process of researching.

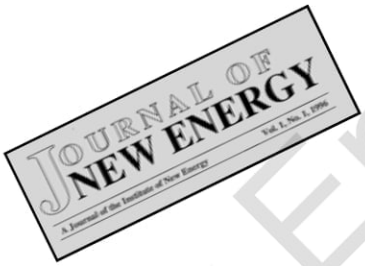
Reviewer response to Section 111: Material and Waste Data was extremely positive. Most were happy to see the amount of information provided in an easy-to-read format in one place. We will use suggestions given to clarify the material even further.

Reviewer response rate to the Cultural Component was low. We sent the Sample Draft to 43 reviewers, and only 10 responded. The low return and type of feedback we received told us that we have a substantial revision ahead in order to make the document clear and useful for readers.

We look forward to having a greatly improved set of materials to send out in March for a proposed next round of cross-site, cross-sector workshops in April. Again, thank you for your cooperation and your feedback. Your participation has been invaluable.

Sharon Lloyd-O'Connor
Program Manager
Washington, DC

I was pleased to enter a position paper on the matter of cold fusion and nuclear waste remediation. ***—EFM***



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Hal Fox, Editor

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"A wonderful philosophical and reflective essay on the nature of the universe as informed by modern science. It is a fine example of how scientific discovery helps shape one's world view in a rational yet compassionate manner."
—the late Heinz Pagels, Ph.D.
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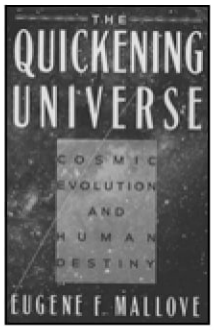

1987, St. Martin's Press, hard cover, 268 pages, illustrated by the author.

What Gene Mallove was writing about—*before* cold fusion and New Energy!

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Asti Workshop on Anomalies in Hydrogen / Deuterium Loaded Metals

November 27-30, 1997 in Asti, Asti Province, Italy

The Asti Workshop from the Organizer's Point of View

by William J.M.F. Collis
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Asking the organizer to write about his own workshop is like asking a mother to describe the virtues of an unmarried daughter. The answers are likely to be personal and incomplete. With that proviso, let me attempt to give my impressions on the meeting.

Apart from ICCF-2 held in Como in 1991 there have been about a dozen or so Cold Fusion meetings held in Italy since 1989. Most of these have not been advertised. Invitation has been by word of mouth and budgets have been very limited. As a result these meetings have generally been attended by Italian academics only.

Conference organizer Bill Collis

Four years ago Fiat, the automobile group, (and other sponsors) invited a group of nearly 20 international experts in Cold Fusion to a private meeting at Villa Riccardi, near Asti. The meeting was followed by a press conference and the first "truffle prize" was given to Yan Kucherov for his pioneering work on transmutations induced by glow discharge. A common interest of Martin Fleischmann and Stanley Pons was gastronomy. The main reason for choosing Asti as the site for the meeting was the chance to eat truffles and drink the local Barbaresco red wine! There was no Cold Fusion going on in Asti!

This format was followed again in October 1995. This time some forty scientists attended and *two* truffle prizes were awarded. One was given to Akito Takahashi for his electrochemical work and the other to Francesco Piantelli for the development of the high temperature gas loading device. It should be mentioned that Fiat was, and still is supporting Piantelli and his group at the University of Siena.

Come 1997, Fiat was not ready to make public announcements on its own development of Cold Fusion and so did not plan to sponsor the Asti meeting. With Fiat's consent and the support of the other sponsors, the author of this article decided rather late to take the initiative. As an Englishman resident near Asti I am ideally placed to make the local arrangements.

I had originally counted on the financial and organizational support of La Sapienza (University of Rome III) and INFN (Istituto Nazionale per la Fisica Nucleare) who in the past had sponsored other Italian meetings. After having been promised this in writing, it transpired that sponsorship would not be forthcoming because the proceedings of a 1995 Italian meeting had still not been published. News of this setback only arrived after initial invitations had been sent. The organizer's nightmare had been realized—I was committed to organizing an international workshop without support. Little did I know at that time, that most of invitations sent out by air-mail would actually reach their intercontinental destinations by surface mail more than a month later. I was risking greater failure by giving insufficient notice to attendees.

I do apologize to all those who would have liked to come but were unable to do so. Perhaps too, I should also have known better than to fix a date close to Thanksgiving Day in the United States. However, in the event I was overwhelmed by acceptances and by all accounts the workshop was a success! In fact, more than 60 people attended at least one of the three days, making the meeting the most popular Cold Fusion workshop on record. Although I had booked all 32 rooms at the hotel Villa Riccardi, this was not enough and two other hotels were filled to capacity!

How was it possible, to transform the situation after such an unpromising start? I think there were several key factors. Firstly the good reputation of the Asti workshops was created by Fiat. Previous attendees of the workshop were amongst the first to accept their invitations. Secondly many of the attendees and sponsors know each other personally. Finally, the speed of e-mail and a web-site make up for deficiencies of the postal service.

The Cold Fusion community has shown the world that the subject still excites extraordinary interest. But one of the most extraordinary things is that "Cold Fusion"—in the sense of fusion of hydrogen isotopes—was hardly mentioned at the entire workshop! A conceptual revolution has been taking place where alternative explanations are now accepted as the most reasonable basis for discussion. In my own presentation, I mentioned, in passing, some data of several years ago regarding Piantelli's gas loading cell. There was so little natural hydrogen in this device that the tiny quantity of deuterium present was insufficient to explain the abundant heat production. This unpublished and preliminary result of course was a bombshell! At a stroke, it demolished the Cold Fusion explanation for excess heat. It also rendered irrelevant the critique of that explanation. "Cold Fusion" is dead. Long live New Hydrogen Energy (NHE)!

I would hope that some of the moderate skeptics will now return to study NHE, comforted by the fact that their doubts on Cold Fusion were in fact justified. Sterile hydrogen fusion theories have never correctly made any significant prediction. Indeed they have made many false predictions (such as the unverified production of ^{3}He from p-d). I think it is fair to say that major responsibility for the lack of progress in the field has been due to clinging to these unrealistic models. One attendee described it as a hardening of the arteries. It is time to cut away the dead wood, reexamine the evidence, and reconstruct predictive theories which can be tested experimentally. Perhaps the Asti workshop has accelerated this process.

The Asti Cold Fusion Workshop—a Pilot for ICCF-7?

by Dr. Peter Glück
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The "Asti Workshop on Anomalies in Hydrogen/Deuterium Loaded Metals,"

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The Group Photo at Hotel Villa Conte Riccardi
Back Row: Don Holloman, Stan Gleeson, Stefano Sanvito, Giorgio Iacuzzo, Danielle Garbelli, Francesco Premuda, Mike McKubre, Jean de Lagarde, Jean Pierre Vigier, Pierre Clauzon, Bill Collis, Jacques Dufour, Bart Simon, Giuliano Mengoli.
Front Row: Linda Holloman, Celine Estille, Christos Stremmenos, Robert Huggins, Giovanna Selvaggi, Jean Paul Biberian, Peter Glueck, Lino Daddi, Tomio Uehara, Hiroshi Kamimura, Naoto Asami, Misa Nakamura
Below: Fulvio Frisone, Sergio Focardi, Francesco Celani

Alas others were in a different hotel or had simply had too much Dolcetto to drink the night before! (WC)
(Photo: Courtesy, Bill Collis)

actually the third Italian Workshop on Cold Fusion, was organized by ENECO Ltd., chief organizer William Collis, one of most enthusiastic promoters of new energy research in Italy. Bill has done a great job, everybody has agreed. Place: Hotel Conte Riccardi at Rocca d'Arazzo, some 7 kilometers from Asti, the capital of Asti province—a very beautiful area of a wonderful country. Timing: Nov 27, Thursday-Nov 30, Sunday 1997. Participants: some 60 cold fusioneers, experimentalists, and theorists from Italy, the US, Japan, France, England, Germany, Canada, and Romania. Many of the international leaders of the field were present. Organization: perfect, in my opinion, excellent conditions for the lectures (16) and the posters (5), and what is even more important, the best opportunities created for professional scientific discussions, for networking and collaboration. Please do not forget the fine hotel, tasty food, and world leader quality wines, both red and white. Sponsors, besides ENECO: (names in Italian, difficult to translate exactly)

--Fondazione Cassa di Risparmio di Asti
--21 mo Secolo Scienza e Tecnologia
--L'ACN- L'Accessorio Nucleare srl
--Associazione per lo Sviluppo Scientifico e Tecnologico di Asti
--Orim srl
--The Cincinnati Group from USA
--*Infinite Energy* Magazine

[Editor's Note: Some 60 pounds of magazines and brochures sent to the conference by INFINITE ENERGY were unfortunately *lost* by the US or Italian postal authorities!]

General impression and problems. The "cold fusion" war continues, on many battlefields. In Japan, CF was defeated [*Officially, but the best work continues nonetheless.*—Editor], the official "New Hydrogen Energy" program will be stopped in April 1998. The reason? "APPALLING MANAGEMENT"—in Martin Fleischmann's words. Excellent science (as demonstrated in the Asami et al. and the Kamimura et al. papers) combined with such management is a perfect recipe for a disaster. "Metrologomania" (focusing on measurement and not on the effect), investing many times more little grey cells in the means as in the aims: a cult for calorimetry displacing and replacing the efforts aiming at a really strong and reliable excess heat effect. We are at a point where the lack of a theory hurts. A great gap between experimental practice and the most bright theories. One of the world's greatest theorists, Jean-Pierre Vigier, asks for a perfect, self-sustained demo, for a public acceptance of the reality of cold fusion. With the existing theories: "We all are walking in the fog," as somebody remarked. More or less true. Existing theories which try to reconciliate the experimental facts with classical physics cannot help, we need new thinking for the new reality. A brand new paradigm, back to the very basics. Not consulting with the successful workers (as Prof. Yoshiaki Arata in Japan). Not accepting reality: the classical bulk Pd/D_2O system is not able to scale-up. Some ways are good, some not; we had enough time to make the difference. "Errare humanum est, perseverare diabolicum" has to be applied. CF is progressing through some leading, creative groups. The Cincinnati Group is one of these and it was at Asti. It has shown us some very valuable and interesting things. We regretted the absence of the president of Trenergy, Inc. (Hal Fox) who intended to speak about plasma-injected transmutation. A strongly polarized field----good perspectives for LENR/LENT as concluded from the paper of George Miley and the results of the Cincinnati Group near Mike McKubre's unforgettable lecture concern-

ing the tremendous difficulties inherent to the classical Pd/D_2O cell and near the NHE papers. Somewhere in the middle, we learned that the Italian Piantelli et al, system is not dead at all; it is claimed to be nuclear; Piantelli is working separately from his colleagues; scale-up is more difficult than I thought. Good, but not excellent results are coming from France but this is only a new start. Perhaps I was right stating the truism that the greatest peril and obstacle for CF is irreproducibility and that a solution for the future needs clever management and strategy. ICCF-7 is coming soon, and if the organizers will learn from the Asti experience, the number of errors and blunders in the field will decrease.

First Day: Thursday, November 27.

William Collis: Introduction. Our host described the history, leading principles and ideas, the "raison d'etre" of these workshops, a general image of cold fusion, some open scientific and some settled (and well settled) organizational problems. He is promoting the foundation of a European CF community/ organization; he suggested the nice name of HEIDI (we all like very much Johanna Spyri's novel about the Swiss girl called Heidi), that is HYDROGEN ENERGY INNOVATION AND DEVELOPMENT INSTITUTE. This is conceived as a multi-national, industry sponsored organization. Good idea; I hope it will become a reality.

Naoto Asami: "On the Material Behaviour of Highly Deuterated Palladium." A comprehensive study, performed in the frame of the now moribund NHE national Japanese plan. The optimum methods for obtaining a high D/Pd ratio in cathodes are presented and the metallurgy, structure, texture, phase composition of the hydride are thoroughly studied. A great part of these data can be found in two papers published in the *Journal of Alloys and Compounds*, 253-254, 1997, p.185 and p. 657. Unfortunately, even the highest D/Pd ratios couldn't generate strong, repeatable, reliable excess heat.

George Miley: "Transmutation Studies Using Thin Film Electrolysis." The lecture started with the announcement that the American Nuclear Society Meeting planned for 1998 will have a special (official!) session dedicated to the low energy nuclear reactions. In my opinion, this lecture was the highlight of the workshop. We learned about the decisive advantages of the thin-film systems, about the open problems, the complex analytical problems starting with adequate sampling, about all the possible impurities, isotopic shifts, theory based on the swimming electron layer concept. The task of making material and energy balances are immensely difficult for the moment. A must-read paper. The audience did not learn about the recent technological progress made by CETI, the company which created the first technologically viable thin film systems; however it seems that the prospects are really good.

Francesco Celani: "The Effect of Gamma/Beta Phase Interface on (H/D) Overloading." Francesco Celani and his team won the Truffle Prize of the workshop

Dr. Francesco Celani accepts the Truffle Prize from Bill Collis

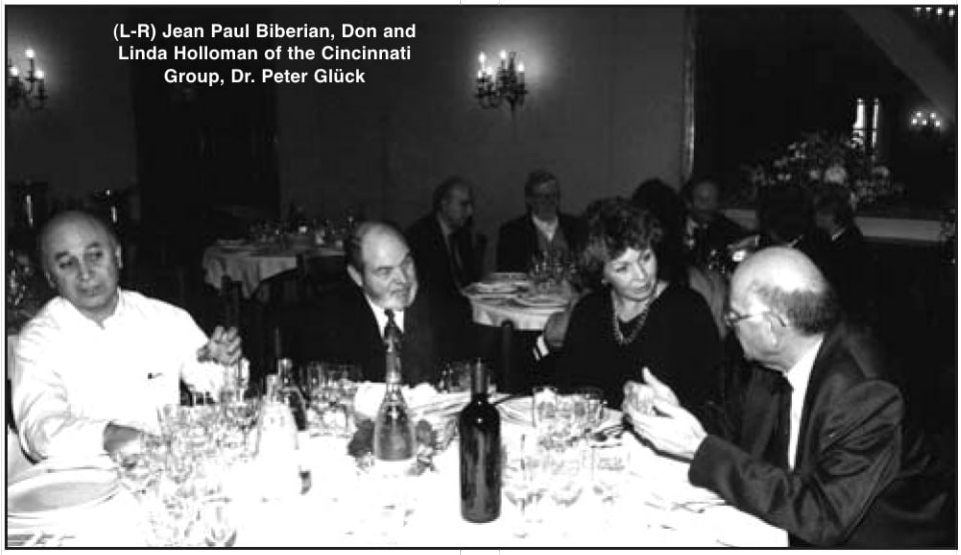
for their global achievements and creative contribution to the CF field. He pioneered the use of high-frequency pulsed current and very long Pd wires for Pd loading. Great expertise in electromigration. Despite his innovative methods and very advanced calorimetry, the system still "offers" surprises. It was a front-line report, and we wait eagerly for a continuation.

Felice Iazzi: "Techniques for Loading and Controlling the Deuterium Palladium Atomic Ratio." A study aiming to find neutrons, with clever combination of gas loading and electrochemical loading methods. They use gold plating and electro-migration to achieve high loading ratios and to avoid deloading.

Hiroshi Kamimura: "Excess Heat Measurement by Fuel Cell Type Electrolysis." Another study performed in the frame of the NHE program, with bulk cathodes. The results are entangled in the very subtleties of the high art of calorimetry, 7-18% excess found with one kind of measurement, not confirmed with an other kind (isothermal vs flow calorimeters). Anyway, marginal results are not useful in long range; we need more than some 300% anyway, for a self-sustaining demo and for practical applications.

Stefano Veronesi: "Study of the Ni-H system at 600-800 deg K." This is about the Piantelli-Focardi-Habel system, work is continuing. This study has demonstrated that the source of excess heat is nuclear reactions (gamma radiation is found). I asked if the nuclear signals are in concordance with the heat measured and got what I thought was an affirmative answer, but Bill Collis states that they do NOT have nuclear products commensurate with heat!

Their calorimetry was questioned by Jacques Dufour. Sergio Focardi, the co-author of the first paper on this system explained to me that there are problems with the scale-up of the heat excess effect. On other hand, Piantelli is working now independently; we learned that the FIAT company will continue to fund his studies. I did not understand exactly what had happen in this area. I was happy enough to see the system alive. After the dinner, a round table discussion was organized aiming to prepare the press conference of the following day. The discussions were dominated by the temperamental theorist,



(L-R) Jean Paul Biberian, Don and Linda Holloman of the Cincinnati Group, Dr. Peter Glück

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Giuliano Preparata, who pleaded energetically for straight attacks against the scientific establishment. The more moderate and diplomatic approaches (e.g by Collis, Vigier, Biberian and myself) the last based on a presentation of the technological prospects of the field, as those of CETI, CINCY, E-QUEST, ARATA, BLACKLIGHT-POWER etc. couldn't convince the "radicals." The possibility to persuade the Establishment by using a perfect theoretical demonstration was questioned by many, including Vigier himself.

The second day: Friday, November 28.

A press conference was organized at the Cassa di Risparmio di Asti, actually a great bank which is cleverly sponsoring innovative research. We listened to speeches of the organizers and the local authorities, Professors Preparata and Stremmenos told about their opinion regarding the Scientific Establishment. However, everything went well, Francesco Celani got the prize, a great genuine truffle and a Cincinnati Cell. Other speeches were made by the beautiful Celine Estille representing the Cincinnati Group, photographs were taken of the prize-winner— no questions came from the press. Next point in the program, a splendid luncheon banquet at the elegant Hotel Reale. Exquisite, very high level. Then a visit to the Contratto Wine Cellars in a small town called Canelli. I got a lot of information about how that highest quality wine is manufactured—to be included in my course in Management of Technology. Back to the hotel Villa Riccardi; the guest of honor, Martin Fleischmann has just arrived.

The third day: Saturday, November 29.

Jacques Dufour: "Effect of Hydrex on a Photoelectric Cell." Dufour's excess heat studies (rather complex and not directly scalable) have concluded that there are no nuclear ashes and the hydrogen collapse mechanism is at work leading to Hydrex (Deutex) atoms. In the Asti lecture, a very sophisticated but convincing study was presented: the hydrex state is formed due to strong magnetic fields, and excess heat effects were demonstrated by using a photoelectric cell. Dufour plans to present a transmutation effect of hydrex at ICCF-7. His experimental data are in concordance with Vigier's theory.

Bill Collis: "Cold Fusion or Cold Fission?" Collis has developed advanced computer programs for identifying and selecting the nuclear reactions which can take place in cold fusion systems. He suggested that any theory/explanation needs to account for the following observations: very few gammas, few X-rays, He, transmutations of heavy elements, similar levels of excess heat in H and D based systems, tritium and neutrons in H systems, no 14.1 MeV neutrons. Deuterium does not fuel the reaction, technical grade materials work better than pure ones (Mike McKubre especially makes this point). Perhaps the major contentious point here is the idea that H and D are not the fuel in CF reactions. Collis went on to discuss the kinds of nuclear reactions researchers should be looking for and the possibility of basing new experiments on theoretical predictions.

(L-R) Dr. Sergio and Mrs. Focardi with Dr. Francesco Piantelli
[See IE Issue #4 for their pioneering patent]
Photo: Courtesy, Bill Collis

Peter Glück: "The Reproducibility Problem in Cold Fusion Systems." Using a standard managerial technique (SWOT analysis—Strengths-Weaknesses-Opportunities-Threats) and an original classification of the experimental CF systems, Glück opposed the classical bulk Pd cathode/D_2O setup with the so called "evolutive energy" systems based on catalysis and/or cavitation. In his opinion, only the later can lead to viable and reproducible commercial energy generating (CETI, BLACKLIGHT POWER, E-QUEST, ARATA, HYDRODYNAMICS, YUSMAR) and/or LENT (CINCINNATI GROUP, CETI) devices. He predicted that classical theories will continue to fail in explaining the new phenomena, a radical paradigm shift will be necessary. Management is the key to the future development of the field.

Celine Estille *of the Cincinnati Group reads Press Release* ***in Italian!***

Giuliano Mengoli: "The Nickel-K_2CO_3 System: an Electrochemical and Calorimetric Investigation." Obviously, Fleischmann's choice; an excellent electrochemical study with innovative calorimetry. It's value and beauty is in the details and these can be understood only by reading the paper in extenso.

Jean-Paul Biberian: "Cold Fusion Results Obtained in Grenoble, France." Biberian announced the major good news of the conference. The French government is now officially supporting CF research at Grenoble (talk about a reversal of fortune). The Grenoble group looks to be in good shape for at least the next three years. The program includes replication of the Fleischmann-Pons system, experiments with the CETI cell and work with solid electrolyte devices. Definitely positive results had been obtained, however Biberian is not content with the level of the excess heat effects and is not absolutely convinced about the reality of the LENR results. A very good team and program, anyway, just starting large scale research.

Celine, ***What is your answer?***
Photo: Courtesy, Bill Collis

Jean-Pierre Vigier: "Possible Theoretical Consequences of 'Cold Fusion' Experiments." Vigier's theory of new Bohr orbits is a great achievement per se, irre-

(L-R) Naoto Asami, Kamimura Hiroshi, Tomio Uehara
Photo: Courtesy, Bill Collis

spective of its correlation to cold fusion. According to it, the source of excess heat is the collapse of the hydrogen atom in tight orbits, a concept in the front-line of the theory (Vigier is developing quantum mechanics while Mills is radical and heretical, the future will show who was right). The results of Dufour and that of Szpak are proving Vigier's theory, and in Belgrade a team of scientists is working in the same direction. New details on Vigier's theory will be known from a publication in *Physics Letters A*.

Antonio Spallone: "A preliminary D/Pd loading study: anomalous phase transition effect" Spallone, who works with Celani, reported on some of the Frascati experiments, more studies of Pd loading, more studies of excess heat production using flow calorimetry. Again the importance of dealing with electromigration in achieving high loading was discussed and a warning not to try and load the cathodes too quickly. This is the common theme—in pursuit of excess heat it is wise to design a protocol which can maintain high loading at high voltage. One of the main reasons for irreproducibility of excess heat is the problem of sudden, uncontrollable deloading in the course of an experiment.

Francesco Premuda: "A Unified Theory of Cold Fusion and Superconductivity." Premuda has presented his theory based on the possible formation of special zones in plasma localized in the defect places of the lattice. The ideas have been presented in a very highly mathematized manner. This paper has to be studied *in extenso*. An important aspect is that of the dimensional, structural, and functional characteristics of peculiar places in the lattice; an adequate description/model has to be found. Premuda's theory is stimulating this endeavor.

Michael McKubre: "Materials Issues of Loading Deuterium into Palladium and the Association with Excess Heat Production." A most impressive work, with really tragic elements in it due to the terrifying complexity and difficulty of the subject, perfectly shown by McKubre. Irreproducibility seems to be inherent to this system and ultrafine details can transform a working cathode into a dead one. There are no two cathodes with the same loading-deloading behavior. McKubre reported about almost 8 years of research at SRI with pretty disappointing results, but scientifically clearly positive. My (PG) reaction was radical; "Crush your cathodes, Mike!!"

Vittorio Violante: "Lattice ion trap—classical and quantum description." A theoretical study demonstrating that nuclear reactions in the lattice are possible due to the combined effects of trap force, electrostatic interaction, and non-linearity. Both the classical representation and the quantum mechanical one show an interaction effect between deuterons in the lattice. A theoretical "new wave" work, with many Italian supporters. Posters.

Fulvio Frisone: "Study on the probability of interaction between the plasmons of metal and deuterons." A theoretical work; the author has studied the influence of impurity concentration on the phenomenon of fusing of deuterons, catalyzed by the "efficacious" interaction with the plasmons of the metal. The numeric calculation, conducted on different metals considering the degree of impurities present in the reticulum, shows that the probability of fusion is amplified by the impurities. This result is confirmed qualitatively by the trend of the potential gap that describes the interaction inside the metal (and by many experimental data).

Lino Daddi: "On the detection of cold fusion neutrons by radioactivation." An experimental study and tutorial, describing the principle and practical application of the radioactivation method, specific for the detection of neutrons. A very important example of application of the method to the Siena experiment is presented, where gold activation was used (to be published in *Il Nuovo Cimento*). The method can be used for both the cases of continuous or burst-like neutron emissions.

C. Cammarota, W. Collis, A. Rizzo, C. Stremmenos: "Calorimetric measurements on nickel samples charged with hydrogen" (in Italian). An experimental study, demonstrating exothermal reactions in the system (81 Mcal/mol Ni in 35 days), local melting (!), and formation of craters on the surface of the sample. New elements appear in these craters (study continuing). The most important point of the Bologna work is that the group verified Piantelli's excess heat measurements using mass-flow calorimetry. Conse-quently, the excess heat results are so much more reliable.

First draft of a Report on the Asti Conference: "Fusione Fredda e Tartufo"

by Bart Simon (Dec. 12, 97)
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This is just my first quick draft of events based on my rough notes. I'm going to go back over things this weekend but some of the tapes of the talks turned out poorly because of loud conversations in Italian behind me!

General Observations

Forgive me, but some of you know I have an intellectual obsession with the scientific undead. The scene at Asti was positively gothic. I note the large, empty, aging Villa on top of a hill in an old medieval town, the ceaselessly dark and gloomy sky, the endless drizzle and fog. How could one not expect great things from a place like this?

Bill Collis, the workshop organizer, did a fantastic job. Despite some late advertising, some 60 or so participants attended the 3rd Asti workshop on cold fusion - "Fusione Fredda e Tartufo." Slightly more than half the attendees were Italian CF researchers (Celani, Bressani, Premuda, Piantelli, Preparata, Veronesi, Scaramuzzi etc..). Fleischmann was there, as was Vigier, Biberian, and Dufour. Asami and Kamimura came from the NHE lab, and McKubre and Miley rounded out the U.S. contingent. A fairly complete list of attendee's can be found on the workshop web page (http://www.netcity.it/coldfusion/)

The conference was organized over three intensive days. Thursday morning (Nov 27) started early with papers from Asami, Miley, and Celani. After lunch there were papers by Veronesi (works with Focardi and Piantelli on the Bologna-Sienna collaboration), Iazzi (works with Bressani in Turin) and Kamimura. Somewhere in there we had a coffee break, and just before dinner there was a round-table session meant for discussing what kind of presentation to make to the Italian media. In between all these papers were a series a three-course meals, copious amounts of wine, and all the cold fusion conversation you could handle.

Friday (our day off?) began in the town of Asti with a press conference. The events

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were in Italian, so all I can say is that Bill Collis gave a short speech followed by longer controversial talks by Giuliano Preparata and Christos Stremmenos (Bologna). Francesco Celani was presented with the coveted "truffle prize," which was a giant white truffle that we could smell 10 rows back from the podium. The Cincy Group (Cincinnati Group) was also on hand, and made a short public announcement. I'm not quite sure what the fallout from the press conference was, but since there was not a single question from the floor, I don't expect much. No matter, selling cold fusion to the press was not the purpose of this workshop. We adjourned to the Ristorante Reale and proceeded to scarf down a 15-course lunch (I finally tasted white truffles!). The day proceeded in a similar spirit, a trip to the Contratto winery, where we witnessed some great baiting of the tour-guide from Jean-Paul Biberian over the wine's status as champagne-like. Following this... more food and then...more food.

Saturday picked up where we left off on Thursday, with papers from Dufour, Bill Collis, Peter Glueck, Giuliano Mengoli (from Padua I think), Biberian, Vigier, Antonio Spallone (works with Celani), Francesco Premuda (Bologna), McKubre and Vittorio Violante.

Overall there were no real bombshells, but the workshop was productive, if only in terms of communicative aspects. I witnessed lots of worthy technical exchanges and agreements to collaborate. I gather that the various Italian groups don't maintain such tight links, so the workshop was no doubt helpful for them. All the Italian groups, by the way (except Piantelli), are suffering from the bad press and cutting of research support and the mood was not encouraging on this score (this was balanced by good news from the French however—see below). In general I think people were impressed with the level of technical/experimental competence and the increase in practical knowledge of materials, calorimetry, and other elements of experimental protocol, but the mood was sour about the lack of some kind of result that could bring CF work back into the mainstream. My read on this is something of a sense of impatience and frustration (except for the French researchers who seemed pretty happy really).

There was an attempt to talk about the possibility of some more integrated synthetic research effort perhaps orchestrated through the formation of an international society of some kind, but this discussion didn't get very far—I imagine it will come up again in Vancouver (ICCF-7, April 1998). I have plenty of sociological observations to make, but I will do my best to avoid this, so I can try to produce a better sense of what was discussed. I will do my best to summarize the basic points of the papers in brief synopses below.

Naoto Asami: "On the Material Behavior of Highly Deuterated Palladium"

Asami reported an extensive series of experiments looking at the various material properties of the cathodes (grain size, surface treatments, preparation techniques, etc..) and their effects on loading.

(L-R) Dr. Peter Glück, Linda Holloman, Dr. Martin Fleischmann
Photo: Courtesy, Bill Collis

A major point seemed to be the problem of lattice deformation during electrolysis (a point McKubre focused on) and there is a need to reduce the effects of lattice deformation in order to achieve higher loading ratios. I gather there is not too much that is new about this (I remember these discussions in Maui at ICCF-4) except that I get the sense that the NHE crowd has accumulated a lot of useful data on this loading question. I just wonder, like many others, about the extent to which high loading is necessarily tied to the production of excess heat. Asami did not report the measurement of excess heat using their new flow calorimetry set-up.

George Miley (University of Illinois):

Miley started with a background on investigations in the phenomena of LENR (low energy nuclear reactions). I didn't notice a whole lot of new data, but Miley is taking the problem of impurities very seriously and I am pretty much convinced that LENR observations are moving into the mainstream of cold fusion thinking, forcing the conventional Pd-D electrolysis types to take notice. Miley listed a number of observations that need to be accounted for: Relatively large rates of reaction, the appearance of four distinct atomic mass zones (for the products observed), the lack of energetic radiation, the lack of isotope trends, and the uniqueness of the thin film coatings for producing a significant result. Miley, as many of you know, proposes his RIFEX model for what is going on. This is beyond me, but one important feature of the model is the implication of a high degree of predictability for the kinds of fission reactions taking place. On this score, Bill Collis offered to "run the numbers" to see if he could specify exactly what kinds of stuff Miley should be observing at the end of the day. Some predictability would be nice I gather, because at the moment it seems as if lots of surprises are turning up in these LENR reactions.

Francesco Celani (Frascati)

Ok, I had a hard time following the main point of this paper. Celani uses thin wire Pd in a high power pulsed electrolysis rig. The main claim to fame here is huge XS-heat using high voltage and the big focus here is reproducibility and the issue of electromigration. I learned some more about how the Pd wire loads unevenly and it seems that the uneven loading sets up a fine dynamic balance which allows for the production of XS-heat at high voltages without too much loss of Deuterium (which would kill the reaction). A central feature of this discussion is the relationship between the beta phase and gamma phase of the metal—how to get high loading without diffusion (and I must remember that there is no consensus on the existence of a gamma phase).

Stefano Veronesi (Sienna)

An Ni-H gas loading set-up. Calculates XS-power in the range of 20-60 watts. One graph shows a temperature increase during input power decrease (this is always a good sign). But the big news is neutrons from gammas using gold activation—looks like a few thousand neutrons/sec and a very clear peak. The emission is not constant, but occurs in bursts and some sustained low activity. I gather the gamma peak appears during the early stages of the experiment—ostensibly in the loading phase. In any case there is no evidence of XS-power when the peak appears. As I understand it though, the same experiment produced the peak and then the XS-power. Apparently there is also some evidence of transmutations but I missed the specifics on this.

I gather reproducibility is an issue here for people. Dufour, for one, was not too happy with the calorimetry. People were impressed with the gamma peak, and a few people were agreeing that this kind of clear nuclear signal is what cold fusion

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research needs right now.

Felice Iazzi (Turin)

I thought this was nifty experiment (if it helps, I think McKubre thought so too). Again the electromigration issue comes up to stave off diffusion, the Turin group gold-plates the ends of the Pd cathodes and report 1996 loadings of 0.8 or so along with He-4 (in one experiment). They were apparently already to start a new spiffy set of experiments when their funding from Fiat got axed. An important protocol item is that electrolysis at high currents is a good thing but the current must be increased slowly to avoid the deloading problem.

Hiroshi Kamimura (NHE)

Kamimura ran though the history of some of the NHE electrolysis experiments. As everyone now knows, they haven't been too successful on the XS-heat front. The crucial point of this talk, however, was to present the weirdness associated with the fact that XS-heat that appeared reproducibly (in 1996 40% of cells had XS around 15%) in their old isothermal calorimeters disappeared in their newer flow calorimeters. I would have guessed that this would suggest that the NHE XS was an artifact of the early calorimetry, but people took this as real weirdness which might question the suitability of flow calorimetry in certain cell designs (McKubre especially seemed to take this seriously).

Jacques Dufour (Shell)

I am a Dufour fan but this latest set of experiments were extremely hard for me to grasp. Dufour, unlike most, has increased funding from Shell (an oil company!!) to expand his research program. Dufour is clearly trying to design new experiments in accordance with a theoretical model following the Vigier-Mills route (i.e. the shrunken H atom). Dufour's own speculation concerns the existence of a hydrex/deutrex state under the influence of a strong magnetic field. The new experiments make use of photovoltaic cells as XS energy detectors and this is the limit of my ability to understand what's going on.

Bill Collis (Bologna)

Collis talk started by pushing the theoretical possibility of fission reactions in cold fusion systems sparked by the LENR results. Collis' thinking draws on the ideas of Kucherov and Hagelstein. He suggests that any theory/explanation needs to account for the following observations; very few gammas, few x-rays, He, transmutations of heavy elements, similar levels of XS-heat in H and D systems, tritium and neutrons in H systems, no 14.1 MeV neutrons, Deuterium does not fuel the reaction, H isotopes are a common factor, technical grade materials work better than pure materials (McKubre especially makes this point). Perhaps the major contentious point here is the idea that H and D are not the fuel in CF reactions. Collis went on to discuss the kinds of nuclear reactions researchers should be looking for and the possibility of basing new experiments on theoretical predictions.

Peter Glück, The Reproducibility Problem in Cold Fusion

Glück presented a chart schematizing the various experimental approaches to the production of CF phenomena and proceeded to point out that in relation to a number of the more commercialized ventures (CETI cell, Griggs device, sonofusion, Cincy cell etc), the conventional Pd-D electrolysis route amounts to barking up the wrong tree (or beating a dead horse, whatever). For me Glück highlighted a kind of entrenchment of the Fleischmann-Pons exemplar within the CF community, but there is mounting pressure to change the approach especially given the demise of the NHE program. I think people in the audience were basically agreeing with this, but that the kinds of experiments Glück is in favor of are hard to integrate into the existing research programs of many of these university-based folks. A key exception perhaps is Jean-Paul Biberian's project which involves testing these other promising approaches where he can.

Dr. Francesco Celani holds a Cincinnati Group Cell as Don Holloman explains.
Photo: Courtesy, Bill Collis

Giuliano Mengoli (Padua)

I found this talk very hard to follow and understand for some reason, but if its any help, Fleischmann was extremely impressed. Mengoli is working with Ni-H systems and is also interested in the relationship of materials properties and H loading.

Jean-Paul Biberian (Grenoble)

Biberian announced the major good news of the conference. The French government is now officially supporting CF research at Grenoble (talk about a reversal of fortune!). The Grenoble groups looks to be in good shape for at least the next three years. Biberian discussed results of the FP-cell replications as well as their current work on the Patterson cell. As people know, Grenoble was getting XS-heat from their reproduced FP-cells although not great wads of XS-heat. Biberian's group is obviously very attentive to controls and issues related to testing and this work should be strong evidence to force on the pedantic CF critics. There was less discussion of the CETI replication—Grenoble has a RIFEX kit but they really are after XS- heat. From what I can gather in their own CETI copy they have observed around 12-13% XS-heat and some evidence of transmutations.

Jean-Pierre Vigier (Paris)

I think I am a bigger fan of French CF than Italian. I know I prefer Vigier's enigmatic theorizing to Preparata's charismatic style. Vigier is still on the idea of new Bohr orbits and he is still pushing the need to do experiments which would try to test one theory or another—check out his latest paper in *Physics Letters A* (perhaps its not quite out yet). Vigier cites Dufour's work in support of his view and also the work of Stan Szpak (in collaboration with a few of us at UCSD, by the way). The big news for me here is Vigier's prediction of the observation of a new Balmer series for Hydrogen with the extra line(s) for the new energy states. Spzak's work, Vigier says, confirms this. The mantra here is the same as before—look for soft X-rays. Um, is this not a pretty important discovery irrespective of CF? Anyway, Vigier's friends in Belgrade (I'm not sure who) are at work on a confirmation of this.

Antonio Spallone (Frascati)

Spallone (works with Celani) reported on some of the Frascati experiments—more studies of Pd-loading, more studies of XS-heat production using flow calorimetry. Again the importance of dealing with electromigration in achieving high loading was discussed and a warning not to try and load the cathodes too quickly. This is common theme—in the pursuit of XS-heat it is wise to design a protocol which can maintain high loading at high voltage. I gather that the major explanation for the irreproducibility of XS-heat is the problem of sudden and unpredictable deloading in the course of an experiment.

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Francesco Premuda (Bologna)

I really wanted to follow this talk, but I couldn't (must have been the wine at lunch).

Michael McKubre (SRI)

The issues always seem clearer to me after I hear McKubre talk about them. The good news is that in the wake of the NHE decline, the SRI group will be back on track with some DARPA funding (Hagelstein is involved as well) to work specifically on a demonstration experiment. The bad news was that McKubre reported on his more than 8 years of research on CF with the production of pretty disappointing results. The good news is that McKubre turned the past into an exercise in materials research an attempt to explain why some cathodes "work", and some which should work do not. I'll skip to the conclusions, but again this all revolves around the loading/deloading issue. McKubre suggests that pure Pd is too weak a material and is probe to deformations which lead to sudden deloading—their best batch of Pd was technical grade stuff. This suggests that Pd alloys might be better, possibly Pd with boron. The other suggestion is that impurities may have a positive effect on producing XS heat by blunting the formation of dislocation chains. It would be great to see Ed Storms and McKubre have a discussion about this stuff, but Bob Huggins was there at least and he suggested that thin films which aren't really "big" enough to deform may be the best way to go.

Vittorio Violante (Frascati)

This paper looked at particle dynamics within the Pd lattice and my notes on this are fundamentally incomprehensible so again I must apologize.

"Life begets Life. Energy creates energy. It is by spending oneself that one becomes rich."
Sarah Bernhardt

The all-important cold fusion luncheon menu!

«COLLOQUI SULLA FUSIONE FREDDA»

TERZO COLLOQUIO

FUSIONE FREDDA E TARTUFO

PRANZO DI GALA

Ristorante «REALE», in ASTI, Venerdì il 28 Novembre 1997
Sale dell'Alfieri - ore 13,00

APERITIVO

Fresco calice di Spumante Brut Conte Balduino Riccadonna
servito con i giusti e comandati stuzzichini dello Chef

IN SALA AI TAVOLI TONDI BARONALI

Fettine di vitello crudo della fassone con scaglie di parmigiano e tartufo bianco
Tortino caldo di patate e funghi
Fugottino di verdure calde in salsa di peperoni

Agnolotti quadrati d'Asti in salsa oro
Risottino al bagnetto di quaglie

Sorbetto alla mela verde

Cosciotto d'agnello nostrano arrostito e profumato alle erbe
contornato di patate al lardo e di carciofi alla giudea
Medaglioncini di filetto di giovane maiale alla salsa di nocciole e Marsala Florio
Insalata mista d'autunno al condiglione
Piccantino piemontese

Clementine caramellate
Millefoglie al cioccolato

DALLA CANTINA

Spumante Brut Conte Balduino Riccadonna
Arneis 1996 Olivero Antica Cascina dei Conti di Roero
Grignolino d'Asti 1996 Tenuta dei Re
Barbera d'Asti 1996 Superiore Perroncito
Moscato d'Asti 1996 Beria Sant'Antonio di Canelli
Brachetto 1996 d'Acqui Neirano
Grappa Bosso Stravecchia

Workshop Program

Thursday 27 November 1997

8:30-:9:30	Registration of Participants	
9:30-10:00	W Collis	Introduction and Welcome
10:00-11:00	N Asami	On the Material Behaviour of Highly Deuterated Palladium
11:00-11:30	Coffee Break	
11:30-12:10	G Miley	Transmutation Studies using Thin Film electrolysis.
12:10-12:50	F Celani	The Effect of Gamma-Beta phase Interface on (H/D) Overloading
13:00	Lunch	
14:30-15:15	S Veronesi	Study of the Ni-H System at 600-800 °K
15:15-15:55	F Iazzi	Techniques for loading and controlling the Deuterium Palladium Atomic Ratio.
15:55-16:30	Coffee Break	
16:30-17:30	H Kamimura	Excess Heat Measurement by Fuel Cell Type Electrolysis
19:00	Informal Round Table Discussion	
20:00	Dinner	

Friday 28 November

9:00-9:55	Posters on Display
9:15	Group Photograph
10:00	Coach leaves Villa Riccardi for Asti
10:30	Press Conference at the Cassa di Risparmio di Asti Prize Giving
13:00	Luncheon Banquet at the Hotel Reale
16:00	Coach leaves Hotel Reale for Canelli
16:30	Guided visit to the Contratto Wine Cellars
19:00	Informal Round Table Discussion
20:00	Dinner

Saturday 29 November

9:00-9:40	J Dufour	Effect of Hydrex on a photo-electric cell
9:40-10:10	W Collis	Cold Fusion or Cold Fission?
10:10-10:50	P Glueck	The Reproducibility problem in Cold Fusion Systems
10:50-11:30	Coffee Break	
11:30-12:10	G Mengoli	The Nickel-K_2CO_3 System: an electrochemical and calorimetric investigation
12:10-12:50	J P Biberian	Cold Fusion results obtained in Grenoble, France.
13:00	Lunch	
14:30-15:10	J P Vigier	Possible Theoretical Consequences of "Cold Fusion" Experiments
15:10-15:20	A Spallone	A preliminary D/Pd loading study: the anomalous phase transition effect.
15:20-15:40	Coffee	
15:40-16:20	F Premuda	A unified Theory of Cold Fusion & Superconductivity
16:20-17:00	M McKubre	Materials Issues of Loading Deuterium into Palladium, and the Association with Excess Heat Production
17:00-17:20	V Violante	Lattice Confinement - A possible mechanism producing collisions in condensed matter
20:00	Dinner	

Posters

A Rizzo	A flow calorimeter study of the Ni/H System.
F Frisone	Study of the Probability of Interaction between Plasmons of metal and deuterons.
R Shimada	Nuclear Products Measurements by Electrolysis - Vacuum combined System
L Daddi	Detection of Cold Fusion Neutrons by Radio-activation

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An interview with Dr. Randell L. Mills of BlackLight Power, Inc.....

by Art Rosenblum, *Aquarian Research Foundation*

Randell Mills—New Energy and the Cosmic Hydrino Sea

Editor's Note: We are delighted to have this candid interview with Dr. Randell Mills of BlackLight Power, Inc., who since 1991 has certainly been one of the most important scientists and business persons in the New Energy field. The interview was independently obtained by Art Rosenblum of Aquarian Research Foundation, *before* we were even aware that it had taken place! We thank Art for allowing us to reprint Dr. Mills' interview in full. Though Dr. Mills prefers not to be associated with "cold fusion," as he makes very clear in the interview, the hydrino facilitation of low-energy nuclear reactions are explicitly mentioned in his Australian patent (see this issue pages 67-72). Dr. Mills believes these reactions do not explain the spectacular energy releases.—*EFM*

Conversation between Dr. Randell Mills (RM) and Art Rosenblum (AR) at BlackLight Power

AR: Dr. Mills, this is Art Rosenblum, in Philadelphia. I'm with the *Aquarian Research Foundation*, we've been doing research on the future of the planet since 1970, a small, tax exempt nonprofit, and I'm extraordinarily interested in your breakthroughs in energy.

RM: OK. In very layman's terms, we're catalyzing hydrogen to go to a lower energy state, it's stable, and it explains an enormous number of things that physicists haven't been able to describe or reconcile and it came about from when I was working at MIT. I got a paper on free electron lasers from [Professor] Herman Haus [Ed. Note: of the Dept. of Electrical Engineering and Computer Science], and he was applying non-radiation, radiation that analyzed basically the mathematics of why the free electron laser worked. And I said, "Well, the atom has an electron that's bound and it's not radiating and why don't I apply that math to the equation of the atom?" And I did, and it permitted me to solve everything from the masses of fundamental particles to the rate the universe is expanding—quarks to cosmos—and predicted there were these other lower energy states of hydrogen— and we've amassed massive amounts of data.

We have two term sheets from utilities [utility companies] now. We have people very eager to commercialize this and we've been able to make independent validated energy cells that produce a thousand times the energy of burning hydrogen.

AR: A thousand? I heard a hundred.

RM: Well, that was Penn [Pennsylvania] State University's test, but they didn't do lifetime tests, they stopped that after about 700, 800 hours—something like that, or, excuse me, minutes. They never did lifetime tests. They ran it for a finite period of time. We have done lifetime tests here with Atlantic Electric and gotten a thousand times the energy of burning hydrogen.

Dr. Randell Mills (R) and Art Rosenblum of Aquarian Research at BlackLight Power, Inc. in Malvern, Pennsylvania

AR: I see. Now what happens with the hydrinos? They, from what I read, go off into space but would they also combine with oxygen and form water?

RM: No, they can't burn. I had a utility executive ask me this and he said: "How can I go back and explain this to my Board of Directors? Once you make this low-energy hydrogen, can it come back up to its normal energy level?" Because it's at a very, very low energy level, it's released quite a lot of energy, and it turns out it can.

Now the way to describe that, in layman's terms, is if you take hydrogen and oxygen and burn it and you get water. What is the likelihood that water will spontaneously absorb energy and revert back into hydrogen and oxygen. So, first of all, you cannot get low energy hydrogen to revert back into normal energy hydrogen unless you hit it with a cosmic ray or some very energetic particle and completely knock the electron away from the newly-formed low-energy hydrogen.

Secondly, the electron is at such a very, very low level, it's impossible for it to react with anything other than another low energy hydrogen atom.

AR: So, I see, the electron can only react then with another low energy hydrogen....

RM: Another molecule, and the molecules are very very stable. In fact, I have some beautiful data from the infra-red spectrum of the Sun taken from a number of very, very prestigious telescopes from around the world, including the National Solar Observatory, that match the rotational spectra of this new form of hydrogen, with lines that they have not been able to identify to significant figures. I mean, they match at six places.

AR: Wow!

RM: Yeah. There's about, I don't know, maybe sixty lines, something like that, that match up. And they haven't been able to figure out what it is. And, all in all, there's about a hundred—there's probably about two hundred spectral lines from interstellar media, from the solar corona, and a number of astrophysical studies haven't been able to be explained.

Now let me tell you the significance of that. It turns out there's a long-standing mystery about the Sun. Scientists don't know why the gases around the Sun are two million degrees and the surface is only six thousand. Usually heat flows from a hot body to a cold body, if the energy is being produced in the core of the Sun how is the gas around the Sun hotter?

Well, it turns out that the Sun has a very, very large number of spectral lines that can't be identified and they correspond to the energy transitions of this new low energy hydrogen. And the power from the intensity of those lines matches the amount of power that can't be explained

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by nuclear reactions occurring in the Sun. I'm referring to the solar neutrino paradox, which proves that the Sun is not making all of its energy by nuclear reactions—about half of it is unaccounted for.

The other thing that is a very big problem in astrophysics is that if you look at the Milky Way galaxy, it's rotating a lot faster than it could possibly rotate and be stable. It should fly apart, because there's not enough gravity to hold it together—and that's why they propose that there is this dark matter, this material that does not emit visible light, or light of known spectral characterization. That is, every element has its own particular spectrum and they have found that, if they look at the known elements from the spectrum of our Milky Way galaxy, there's not enough mass there with known elements to hold it together. There has to be some other, unknown element holding the galaxy together and they call it dark matter. I don't know whether you have heard that.

AR: I've heard it, yes.

RM: And it could represent up to 95% of the mass of the universe. It turns out that scientists have looked in the extreme UV region of the spectrum that's much higher energy than visible light, and every one of the spectral lines for these low energy transitions of hydrogen appear in that spectrum. In fact, this low energy hydrogen is this missing mass, this dark matter.

AR: Aha!

RM: And that shouldn't be a surprise, because most of the visible matter, about 95% of the visible matter is, in fact, hydrogen.

AR: That's hydrogen at normal energy?

RM: At normal energy, right.

AR: I see, so what causes hydrogen at normal energy to become low energy hydrogen?

RM: Well, it turns out that there is another mystery of the Sun. If you look at the spectrum of the Sun, you see when electrons of atoms undergo transitions, there are very, very sharp spectral frequencies. In other words, energy is characterized by a very, very specific frequency. Do you follow me?

AR: Yes.

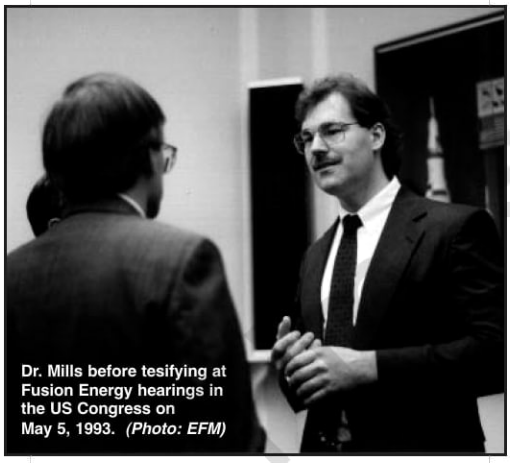
RM: Like a radio station. It isn't very broad, it's one particular frequency. The pattern of those identify the different elements.

AR: Right.

RM: Well, it turns out if you look at the Sun itself, at the photosphere— that's the big glowing ball—if you look at that through a spectrum, you'll see starting at about 912 Ångstroms, going all the way to about 350 Ångstroms, is one big massive broad band that is not a line spectrum. They call it the "912 wedge" and that is called a continuum peak. In addition, there is another big wedge superimposed on that which starts at about 734 Ångstroms. In other words, it's hundreds of Ångstroms broad and it should only be tenths of Ångstroms. You follow me?

AR: Right.

RM: It turns out if you have three hydrogen atoms collide simultaneously, two of those hydrogen atoms interacting with a third can make the....excuse me ... two of the hydrogen atoms, say the second and third acting with the first, can catalyze it to go to its fractional state, one-half.



Dr. Mills before tesifying at Fusion Energy hearings in the US Congress on May 5, 1993. *(Photo: EFM)*

We have people very eager to commercialize this and we've been able to make independent validated energy cells that produce a thousand times the energy of burning hydrogen.

AR: What do you mean "fractional state, one half"?

RM: Well, if you take the Rydberg formula, you know the principal energy level formula of hydrogen, 13.6....let me write this down, this will tell you exactly what we're doing. Very simple— take the formula 13.6 eV divided by n-squared. In the theory—alright, let's go back even further—in 1886, Rydberg recognized that if you look at the spectrum of the Sun and you look at all the infinite number of lines coming from the Sun, if you are going to put integers in that formula, take the difference between those energy levels, it would assign every line coming from the Sun, with the spectrometers of the day. Because the lowest energy transition in that formula was n is 2, until they developed the UV spectrometer then the lowest energy then was n is 1 and that's called the Lyman series. And then, in 1886 Rydberg put the whole thing together—Balmer, Paschen, Lyman —that is the different transitions, transition theories in the Sun going from 2 to 1, 3 to 1, 4 to 1, 5 to 1, that would be the Lyman; going from 3 to 2, 4 to 2, 5 to 2, 6 to 2, that's the Balmer series.

OK, Paschen's 4 to 3, to -3, 6 to 3 etc, in other words, 3 is the final state that's the Paschen series. So, there are all these series of lines and Rydberg completely summarized all of them by saying "Well 13.6 over n squared [n^2], where n is an integer 1,2,3,4,5,6,7,8 to infinity. Now, that would correspond to the ionized electron.

Well, what I'm saying is n can not only be an integer, n is 1 is the first non-radiative state but n is one-half [n=1/2] is non-radiative and stable, n is one-third [n= 1/3] is non-radiative and stable, n is one-fourth is non-radiative and stable.

AR: Non-radiative and stable, you're saying?

RM: Stable, yes. And to go from these non-radiative states—from one non-radiative state to another non-radiative state—you need a catalyst. You need a resonant energy transfer that takes away part of the energy in a resonant transfer, and makes the atom unstable, and then the rest can be emitted as light. And that's what you're seeing from the Sun and from the interstellar medium. And no-one knows why flares occur. The Extreme UV Explorer looked at a flare on a DM planet called A-Microscopae, about this time two years ago and, it was published in *Science* last year by Boyer at the Extreme UV Center at Cal-Berkeley, and every single line in order of energy, fit that formula 13.6 over n- squared where n was 1 over I, I being an integer. In other words a half, a third, a fourth, a fifth, a sixth—in that principal energy formula. Do you follow me?

AR: Yes.

RM: All of them were noted in *Science*, the magazine *Science*, as being unidentifiable. Do you follow me?

AR: Yes

RM: So, it turns out that the electric field between the proton and the electron has a lot of energy stored in it. Right, if you talk to the Tokamak guys up at Princeton,

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which are now closed down, because they wasted total world-wide about $40 billion of taxpayers' money. But there's a much more elegant way of making energy from hydrogen. They didn't have to push the protons together to get fusion, there was a tremendous amount of energy between the neutron and the proton. They just have to find a way of releasing it.

Like they are putting in the equivalent amount of energy of a million electron volts because there is, in fact, a million electron volts of potential energy in the proton's field, so two like charges repel each other with that amount of energy. If you had the opposite charges you should get that much energy back out, right? But you can only get out 13.6 [eV] because that is the first stable non-radiative state, and you have to have a mechanism to release more energy from hydrogen.

Of course, it's known that hydrogen atoms react to form molecules and release even a little more of that energy, right? But they did not do it radiatively. Over the entire universe you'll never see the bond energy of molecular hydrogen formation. You have to have a third body to take away the energy.

Do you follow me? That's what we're doing, we're taking away the energy with a resonant...like an energy sink, that matches the amount of energy that hydrogen will give off to undergo transition to these other non-radiative states.

AR: OK, now if the hydrogen....

RM: How does it happen in space? Well, once you make one-half it becomes auto-catalytic. It turns out that the potential energy of the hydrogen atom is 27.2 [eV], the amount of energy you have to remove in order to undergo these transitions between, let's say from the n is 1 state, the n is one-half state is 27.2 [eV]. That's the amount of energy you have to remove and then once you form fractional hydrogen it has a binding energy of a multiple of 27.2 [eV] and becomes auto-catalytic.

So, what you are seeing in space is, in fact, low energy hydrogen, auto-catalyzing to lower and lower energy states.

AR: I see.

RM: That's all explained on the web page, I mean the balance reactions etc.

AR: OK, but I'd have to be a physicist to fully understand it. My brother is one.

RM: Well, let him take a look at it, he can translate it for you.

AR: OK. Tell me one simple thing. Say the world was producing a tremendous amount of power this way, all over the world, there would be this huge number of hydrinos going off. What would be the effect of that?

RM: Actually, it's very, very little because there's very, very little mass balance. Because, in other words, low mass flow——because you get a tremendous amount of energy. I mean we have independently

Dr. Mills (C) at Fusion Energy hearings. Robert Shaubach of Thermacore (L) *(Photo: EFM)*

validated now of a thousand times the energy of burning hydrogen. So you'd use very, very little material.

You would use water, it would be consumed, the water would be going to releasing oxygen, which would be good for the environment, and it would be releasing lower energy hydrogen. In fact, there is enough water just released in the atmosphere, in the biosphere, from the burning of fossil fuels—that will last for hundreds of thousands of years, just removing that water.

..the Tokamak guys up at Princeton... are now closed down, because they wasted total world-wide about $40 billion of taxpayers' money. But there's a much more elegant way of making energy from hydrogen.

AR: But water is plentiful, we know.

RM: Not only that, I mean if you look at a car application. A 200 hundred horsepower car going 60 mph using this process will go a hundred-thousand miles on a tank of water.

AR: Aha.

RM: With no pollution because what you form is a lower energy chemical form of molecular hydrogen that does not react. In fact, you can look at the spectrum of the Sun and you can see the spectrum of lower energy molecular hydrogen, and it's stable at 2 million degrees. It won't even react or fall apart at 2 million degrees!

AR: I see.

RM: It's lighter than air, so it goes out into space. And if you are worried about something in the gas, it's non reactive. You can breath helium, you can breathe argon, you can breathe neon. Every time you breathe, 80% of the air you are breathing is nitrogen that doesn't react with anything in your body.

AR: Exactly.

RM: This is much more stable than nitrogen. Much, much more stable. In fact, you couldn't even *keep* it in your body. You couldn't even keep it in the atmosphere—it would just diffuse out into space because it's very, very light and it travels through containers very easily.

AR: Could it be kept in balloons.

RM: Well it would be very difficult. You could probably keep it in a mylar balloon for some period of time, but it would be difficult.

AR: I see. So, much more difficult than ordinary hydrogen?

RM: Oh *much* more difficult to store than normal hydrogen.

AR: You don't think it would have an effect on the ionosphere?

RM: If anything it would absorb cosmic rays, which would be a good thing, and it would revert back to normal hydrogen, which, again, is lighter than air and will end up in space anyhow. So if anything it would be a preventative. You know, it would be like replenishing the ozone layer it would have some screening effect. But there would be so little of it would be negligible. It really would have no impact on anything.

AR: Well it sounds *extremely* interesting. Do you have fuel cells at your laboratory presently producing, or capable of producing energy from, say, hydrogen or water?

RM: We have cells running here that produced a thousand times the energy of burning hydrogen running now. We are doing some tests with Atlantic Electric, and we're not unreasonable about showing that. There's independent validation reports put out on the web if you need some validation. For example, the Penn State University report. Jonathan Phillips

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is one of the authors—he's a member of the International Calorimetry Society and the other author, Stuart Kurtz, is Vice-Chair of the Material Research Institute and a double Chair Professor at Penn State University in the Chemical Engineering Department. He runs the Material Research Institute.

So, and there's a summary of reports from MIT Lincoln Lab., Idaho National Engineering Labs, Atomic Energy Canada Limited, Leheigh University, Brookhaven National Labs, NASA Lewis Research Center [see *IE* issue #7—EFM]— a whole bunch of labs are on the net, if you needed other validation.

AR: Why do you think that this information is not published in daily papers and *The New York Times*?

RM: Oh, it will be. We've kept it all pretty secret while we worked it out. Because it's a very, very difficult process. Because what I proposed... You know, I tell laymen this, they say well hydrogen was experimentally known to have this 13.6-over-n -squared [$13.6/n^2$] formula back in 1886 and they tried to build theories around it and none of the theories really worked, because they tried to make the universe mathematical rather than physical. They conflict with the large scale physics. There's a big problem in physics now, you know— they're up to eleven dimensions now trying to unify gravity and atomic theory, and it's just an absolute *nightmare*. Then after all these decades and millions of man hours, it is not coming about at anything convenient in terms of a solution.

AR: What, in terms of a solution?

RM: And I have something that unifies Maxwell's equations, General Relativity, Special Relativity, and predicts everything from quarks-to-cosmos. It works over 45 orders of magnitude. Now the problem is, I have massive amounts of experiments that I can explain in terms of astrophysics, cosmology—like the entire thing—and I have very very pre-eminent people. I've had probably 200 top physicists from Caltech to Westinghouse, you know, from national labs, multi-national corporations, to top universities have looked at this and no one can find a mistake with it, or a single experiment that proves it's wrong. It's very easy to find an experiment that proves quantum mechanics wrong. The Aspect experiment proves it wrong; electron scattering experiments prove it wrong. It's not reconcilable with gravity. There are plenty of things that prove it wrong. Even if you look at the fundamentals, it's not even a *wave* equation. There is an internal contradiction inside the equation itself because they do a substitution with the deBroglie wavelength and it turns out that it doesn't even satisfy a wave equation. That's why the time-dependent has a first derivative with respect to time, not the second because it's not even really a wave equation. Nonetheless, I'm not going to beat up on it too bad. It predicts negative energy states; they've got to use virtual particles and all these compactified dimensions, all this just weird, crazy stuff. But all this comes out of first principle physics and in closed-form equations from my theory.

Dr. Mills (L) at Fusion Energy hearings in the US Congress on May 5, 1993. Cold fusion scientist Dr. Edmund Storms (C). Dr. Bogdan Maglich (R) *(Photo: EFM)*

A 200 hundred horsepower car going 60 mph using this process will go a hundred-thousand miles on a tank of water.

Think of how it is, if I came up with a new theory and I came up with, say, an eleven dimensional theory or a thirteen dimensional theory that would be OK, that would be perfectly acceptable. But it turns out that my theory says that there are other lower energy states of hydrogen which violates, or is in contradiction to the solutions of one-electron wave equation solution to the hydrogen atom, which is based on probability. And so the universe is not probabilistic at the atomic level, but a fundamental particle is a fundamental particle. It is not a probability density function.

It didn't even make sense to apply probability to a single particle, you know what I'm saying? It's like trying to do statistics on one person! Mathematically it doesn't even make sense, but they used it because they could do these averaging techniques and they could do all these perturbations and get the experimental answers, so mathematically it's very convenient. It's like trying to fit the stock market after you know the answer, you know what I'm saying?

AR: Right.

RM: You apply all these curve-fitting techniques and that's what quantum mechanics really is, it's a bunch of curve-fitting. You add different dimensions, you add virtual particles, and you keep adding negative energy states until you get the right answer. Well here I'm saying that everything's deterministic all the way down to the atomic level. That's going to make these guys look like fools. They're off on the wrong tangent talking about probability. Einstein, de Broglie, Dirac, Schrodinger himself, they all said, "You guys are wrong, you shouldn't talk about a particle being a probability. A particle is a particle." And that's the problem, that's the rub. That's why it took a lot of confidence building and testing. And the other thing was this damned cold fusion! If I did anything I'd rip that out of the history books, because those guys are saying, "Hey, there's some heat source, and we've got some nuclear reaction and, of course, all nuclear products magically disappear, you know it's the same sort of thing as the quantum guys—they're pulling tricks out of their sleeves and they are just trying to hand-wave explanations without anything substantial. You know what I'm saying?

AR: But doesn't cold fusion produce tritium, which is radioactive?

RM: No, it doesn't. I mean, even if it does, let's put it this way. Even if it does, even if you take the numbers that they say it produces as tritium, right? If you take, right you got to obey $E=mc^2$ right? So you have got to take deuterium and then you make tritium and $E=mc^2$, and if you look at how much energy they are getting compared to the amount of tritium they get, it's off by 14 orders of magnitude! I mean that's a big mistake! That's not like 20%, that's 1 followed by 14 zeros.

AR: Right.

RM: That's big. So these physicists say, "Hey, the nuclear reactions aren't accounting for the heat, even if there is trace tritium there, that's not what's making the heat." You see what I'm saying, because they're off by 14 orders of magnitude.

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AR: Right.

RM: So they keep saying, "Ah, well somehow the tritium magically disappears, or you know, whatever—and that doesn't cut it in science, you know, you've got to have experimental data. If you look on the walls I have gas chromatography results, mass spectroscopy results, x-ray photo electron spectroscopy results, infra-red spectroscopy, UV spectroscopy. I have proved that we're making this product from our heat cells, you follow me? That's what people want.

So, over the years I've been building up all this credibility and getting all these validating research reports and now I have two term sheets from utilities, Pacific Corp., which is like the third largest generator, put a million bucks in. We've got other utilities that we're working out deals with for millions of dollars. We're just doing a stock offering, that was a $5-million offering sold out in a week. We are probably going to close it out at $10 million.

AR: Is stock available at present?

RM: Ah, there is but we are only selling it to accredited investors, that's people with like a million net worth.

AR: So your brother couldn't buy stock in the Corporation?

RM: Well, we're trying to just sell to accredited investors. You know people that make like $300,000-plus a year, have more than a million [dollars] net worth—that type of thing. But there's a lot of big corporations, you know, that are.....

AR: Going for it?

RM: Yes, it's very, very interesting to see the turn of events, because in terms of the development time line. I mean, what we originally used is, you have to have the catalyst and you have to have hydrogen in contact with other... The most convenient way of generating hydrogen was with electrolysis. The first cell that I made back in 1991 was with electrolytic...with the transition catalyst dissolved in the water and served as the electrolyte and reacted with the hydrogen. And I got excess energy and I validated at MIT Lincoln Labs and Idaho National Engineering Lab and a number of labs that got very [good] multiples of power out relative to the total input power. But I got linked to cold fusion. People were saying "Well you know, this is 'cold fusion'." What we are doing now is a gaseous reaction at about 100 millitors, which is about one-one-thousandth the pressure of the atmosphere. And up to 2,000 degrees, so you are looking at a very, very low pressure reaction with just hydrogen and trace amounts of vaporized catalyst gaseous reaction. We're getting a thousand times the energy of burning hydrogen.

.... Pacific Corp., which is like the third largest generator, put a million bucks in. We've got other utilities that we're working out deals with for millions of dollars. We're just doing a stock offering, that was a $5-million offering sold out in a week. We are probably going to close it out at $10 million.

And the companies, and Westinghouse nowadays for example, what people said is "OK, we believe your theory, we know this is working, we know you are making lower energy hydrogen, but we don't think it will be commercially competitive."

Dr. Mills (L) at Fusion Energy hearings in the US Congress on May 5, 1993. Cold fusion scientist Dr. Edmund Storms (C). Dr. Bogdan Maglich (R) *(Photo: EFM)*

AR: Why is that?

RM: I'm saying that's what they'd said historically. Then I developed about, I don't know, 18 months ago, I worked out all the theory for this new gas phase cell and then Bill [Good] was working on testing it, and it works! And now we have people, you know, fighting to get in. I mean I get unsolicited calls from utilities, you know, I've got people coming who are CEO's and COO's and Chairmen of utilities flying up in their Lears [Lear jets] and coming here and wanting to license it.

Now, like I said, we have two term sheets already from two different big power generators, and we've got...just last week, I had three more utilities call me. I'm on the road constantly. I mean, the entire next week I'm going to be on the road every single day going to a different meeting.

So, you know, the whole tenor has changed, because now we have a commercially competitive process and I have people from Stone & Webster, Fluor Daniel, Westinghouse and, you know, a lot of big power companies who have said, "If you can get this new vapor phase cell independently validated," they said, "we feel that this will be the dominant source of power for essentially all-power applications."

AR: Right.

RM: Now it doesn't take a genius to figure out if you're getting a thousand times burning you can use a fraction of the electrical output to make the hydrogen out of water.

AR: Of course.

RM: And you're running very low pressures, 100 millitorrs, so it's safe and reliable. If you punched a hole in it, it would just suck air in and shut it down immediately. But because it's very low pressure you can control the hydrogen gas and the catalyst pressures and you can get very, very exquisite control on it. The mass balance is very, very low because you get a tremendous amount of energy per atom, and the product is a lower energy chemical form of hydrogen that doesn't burn, that's lighter than air. So it's very environmentally friendly, and it turns out that the capital cost is very, very low for the equipment also. And you can use existing power conversion equipment, because it runs at very, very high power densities and very, very high temperature. So it's like the ultimate power source.

AR: Well, it sounds extremely interesting and has a lot to do with the future of the planet as I see it, because a major part of our planetary problems is fighting over oil.

RM: Yes, do you want to talk about a really interesting.....we hired this guy, Jim Kendall, who's working out.....I mean in terms of your audience, I think this is really a fascinating concept that he's working on now for our system designs. We just hired him, we're very lucky to get him.

AR: What's his name?

RM: Jim Kendall. He's a Ph.D. engineer type and the thing that's really interesting is he's working on this concept.....it turns out the technology is already available, all the cars are out there in the parking lot. I don't know where you are now, but you know, you look at all these cars sitting

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around these parking lots, sitting in driveways, and all that. You know, a car is a very substantial power station! You could actually take an internal combustion engine and put a generator on it and you can run your car through electric motors, right—from an internal combustion engine? That's what these hybrid vehicles are.

AR: Yes, hybrid is so much more efficient than....

RM: Well, that's what they're talking about. They're actually talking about using some internal combustion engine with a generator and you have electric motors, right? Or they have fuel cells and people at Capstone [Corporation], for example, out in San Diego, is looking at like mini-turbine type of things.

Well, if you ran the internal combustion engine in that mode, you'd have so much carbon monoxide and all kinds of pollutants that you couldn't even breath. Secondly, the gasoline would be so phenomenally expensive and we'd run out of gasoline probably in about ten years, or twenty years.

AR: You mean if everybody in the world lives like we do?

RM: No, I meant if everybody ran their electrical generation off the automobile too.

AR: Right.

RM: But, if you are using *our* process.....gasoline's very expensive, relative to coal. The reason we have centralized power plants is because you have economy of scale for the fuel. Because you can take these huge truck loads and train loads of coal like the plant outside Harrisburg [Pennsylvania] uses 100 car loads a day at 100 tons per carload. That's a lot of gasoline, you know, if you are going to look at that equivalent. That's one power plant.

But the concept is you'd have one of these BlackLight Power cells, making maybe 200 kW thermal and then you'd have a hybrid vehicle. You'd put that into an external combustor gas turbine with a generator on line, so you'd make electricity, and you'd run down the road with electric motors, right? Then you'd park it and you'd plug your car into the grid and it would continue to run and it would generate about 40 kW electric that would go out on the grid. And you would get a credit for it, and then here at home when you are drawing down juice you'd get a debit and the utility company wouldn't even own a power plant. I mean, there's enough cars put out on the road in the United States to more than match the entire electrical generating capacity of the United States.

AR: I got your point. OK, that's very clear. So how close are we to actually producing a fuel cell working with this system that would....?

RM: It's not a fuel cell, it's a gas power cell. A fuel cell is actually a battery, You put hydrogen and oxygen in and then you've got to make the hydrogen. Now if you made hydrogen from electrolysis of water, you'd actually use about four times more fossil fuel than burning it directly. You follow me?

AR: I know that but I don't care about the words "fuel cell," that's right it's a gas cell.

RM: Yes, that's right, just call it a gas power cell, a hydrogen power cell. How close are we? Well, the theory's all worked out, the validations are worked out, the low energy hydrogen's been identified, that is a product, and we have power densities equivalent to many electrical power plants and running at temperatures comparable to many electrical power plants. And we're getting validated energy balance of a thousand times the energy of burning hydrogen. So we know the process works and now it's just the time it takes to retro-fit that into existing technology. We don't have to invent anything new. We're using vacuum furnaces and we're going to use external combustor gas turbines, so it's just a matter of retro-fitting it into existing technology.

So depending on how fast we are at executing that plan and how fast we are getting partners to push that agenda forward, it could happen very quickly. And the thing is, right now we're working on a 100kW thermal unit up at Thermacore at Lancaster [Pennsylvania]. Once we've got that, then you can put that into cars, you can put that into distributed power generation, that could meet [the needs of] developing countries where they don't have transmission lines—that could meet an *enormous* percentage of the market.

AR: Right.

RM: We're probably about six months from having that built.

AR: Six months from having that built?

RM: Right.

AR: Wow! Well, that is extremely interesting and I will let my brother know all about this and it's just fantastic.

RM: You'll be able to get some good stuff off the web. There's some summary there that you could kind of put into an article. We put up a couple of articles there, one that the Lancaster paper *Sunday News* ran I thought was a really good job, and the one that Reuters put out on the news wire.

AR: That's what I have.

RM: Yes, I think between all those, you'll probably get some good information.

AR: And if this is so then, in the next few years, systems will be developed that you spoke of—cars that can run on practically nothing for energy. Energy will be the cheapest thing in the world. Not as cheap as water, but I feel that we won't have a big problem with it.

RM: Well, fuel will be cheap. I wouldn't say energy would be— it's going to cost something because the capital equipment to create electricity or to create motor power. This makes thermal energy. Then you have to convert thermal energy into either motor power or electrical power. That requires a piece of hardware, and we're using existing hardware, namely gas turbines and steam turbines which are reasonably expensive. Compared to the fuel that the vehicle or the fuel that a power plant would use, whatever kind of power plant, the fuel outweighs the cost of the capital equipment, but albeit capital equipment is still a major cost.

AR: But that can come down. How would you say it compares with solar energy?

RM: Oh, solar energy is very expensive because the capital equipment costs are unbelievably high.

So you understand the basic process. We're taking hydrogen and we're making another chemical energy state of hydrogen.

AR: Yes. Now I don't know if anything is still secret if you are applying for a patent, presumably you reveal the secret, right?

RM: Yes.

AR: And so you've got one in Australia, I understand?

RM: Yes.

AR: So the secret isn't a secret any more?

RM: Not a secret.

AR: How then do you convert the hydrogen at low pressure, I don't know what temperature, to hydrinos? Then you've got the power and you have potassium as a catalyst, but what exactly do you feed into the chamber that makes this happen?

RM: You need atomic hydrogen.

AR: Which is separate from molecular

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hydrogen?

RM: You can make atomic hydrogen from molecular hydrogen by dissociation, which is a commonly-known process.

AR: Using an electric arc?

RM: You can make atomic hydrogen using electric arc, you can make it cheaper and more efficiently in terms of capital cost and energy balance if you make atomic hydrogen by just dissociating it on refractory metals at high temperature. If you take tungsten at elevated temperature, it will break—automatically break molecular hydrogen into atomic hydrogen.

AR: Something like the tungsten filament in a bulb?

RM: Tungsten filament in a bulb will do it perfectly fine. The tungsten filament in a bulb is in a vacuum and if you introduce low pressure hydrogen in there, a certain fraction of the hydrogen in that bulb will be atomic hydrogen.

AR: I got it. And then what happens?

RM: Then we take the potassium and you have to have it run very hot. So we run potassium ions, you need potassium$^+$ ions and hydrogen atoms. And we vaporize the potassium ions. We actually heat it up, everything has a vapor pressure, like this desk, the varnish on this desk. If you had a mass-spectrometer ion this room... everything in this room would have a vapor pressure. You heat these metals up, they boil off, and eventually....

AR: That all happens in a vacuum tube.

RM: You boil off and you get the continuous...well vacuum deposition is a commonly known process. So you are in a vacuum, you heat up the potassium, it vaporizes, contacts hydrogen atoms, and there is a resonant transfer of energy, that is, there is a match in the energy level of the hydrogen atom to the difference in energy of two potassium ions for the reaction of electron being transferred from one potassium ion to another.

The potassium ions have other electrons that can be ionized. If you take away the second electron from one potassium ion, and cause that electron to reduce from the first potassium ion, so one goes to K^{2+} and the other one goes to K^0. The energy to do that is 27.2 eV. That is the potential energy of the hydrogen atom when it's in its first non-radiative state. You follow me?

So the potential energy of the hydrogen atom is equal to the energy for transferring an electron from one potassium$^+$ ion to another potassium$^+$ ion. So that hydrogen atom forms that potential energy state spontaneously by emitting light and you can have it form other stable non-radiative states by transferring, in this case *non-radiatively*, 27.2 eV to something else that will accept 27.2 eV.

In the process the electron in the hydrogen atom undergoes a transition to another stable state and part of the energy is transferred resonantly to this catalyst, the rest of it can come out as radiation if you are in a vacuum. In fact, you can see this in those extreme UV lines in solar flares, in the solar corona, you can see it in the dark interstellar media. There's quite a lot of spectroscopy of unassigned lines in the extreme UV from astrophysics, but those transitions match exactly. That is the transitions of taking some of the energy out of hydrogen and it becomes unstable and emits the rest as light. The energy levels are given by the Rydberg formula, which describes the principal energy levels of the hydrogen atom, and the transitions between those principal energy levels gives the light frequencies that come off spontaneously. Those states correspond to the integers in that formula and the states that we're talking about correspond to *fractions* in the same formula.

It's not any fraction it's 1 divided by I where I is an integer. Those are the fractional states. So you have one-half, a third, a fourth, a fifth.

AR: This is physics/math that I don't really understand. What I want to know is something I can more understand. What then happens? You have a combustion chamber of a certain size?

RM: You can think of it as a combustion chamber when you think of a gaseous reaction like inside the cylinder of a car, but this would be much lower pressure. It would be very hot like right after the ignition inside the cylinder. So a vaporized catalyst; then hydrogen atoms that have formed because there's a refractory metal like a tungsten filament is very hot, it breaks molecules into atoms; they contact the catalyst; and by contacting the atoms with the catalyst, energy is transferred from the hydrogen to the potassium, just as when we contact hydrogen atoms and oxygen atoms you get combustion. If you contact potassium ions and hydrogen atoms you get hydrogen going to a lower energy state. The potassium takes away part of the energy. It gets hotter in the sense that it goes to a high energy state. It gives off that energy to the system and returns back to potassium ions, so it serves as a catalyst.

AR: In the vacuum, how does the hydrino then go off, or does it stay until you somehow take it out?

RM: Well, once you've formed fractional atomic hydrogen, it has what we call "binding energy," that is the energy it takes to remove the electron to form a free electron and a proton. It has a binding energy that's a multiple of 27.2 eV. So remember when I told you we had to observe 27.2 to cause the catalysis of hydrogen to the lower states? Well, once you have formed the hydrogen itself in that lower state it has a binding energy of a multiple of 27.2, so it can become its own catalyst. So it becomes auto-catalytic.

AR: The hydrogen atoms gradually become hydrinos?

RM: Yes and they become auto-catalytic to form lower and lower states of hydrinos until one of two things happens. Either two hydrinos react and form a di-hydrino, a molecule, which is stable and doesn't burn and we haven't seen any chemical reactivity at all from this new form of hydrogen, or it's so small it just diffuses out of the system.

AR: Through the container?

RM: Right through the container—as if it's much smaller than helium and it'll go right through the container.

AR: Much smaller than hydrogen atoms too?

RM: Smaller than hydrogen atoms, smaller than helium.

AR: Through the spaces between the atoms?

RM: In the container.

AR: So how does it get out?

RM: Just as if you had a balloon and if you fill it with helium after a while the gas will leak out of the balloon. Because the atom is small and it's neutrally charged so eventually it leaks out.

AR: But hydrogen is still smaller than helium?

RM: No, hydrogen is bigger than helium. The one-half hydrino is about the size of a helium atom.

AR: One half-hydrino, a hydrino that hasn't lost all of its activity...

RM: No. We have normal hydrogen, so let's talk about the fractional states. We have normal hydrogen. Normal hydrogen has a principal quantum number of n is 1 and that has the size of the radius of the hydrogen atom which is 5.29 times 10^{-11} meters. And helium is about 0.56 that size.

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It's about half the size. Now the hydrino, one-half, is half the size of normal hydrogen, or 0.5 the radius of the hydrogen atom.

AR: I see, so it's like a helium?

RM: Very close to the size of the helium atom.

AR: I never knew that heliums were smaller than the hydrogen atom.

RM: Helium atoms are smaller.

AR: OK, because they have neutrons, I would assume.

RM: What does? Yes, but that's the nucleus. The nucleus has neutrons, but the electron is what determines the size.

AR: I get it, so the orbital size of a hydrino is much smaller than that of a hydrogen atom?

RM: Half the size, yes. And then if you go to one-third, it's one-third the size, one-fourth—the lower and lower you go in energy it gets to be a fractional size of normal hydrogen.

AR: Now what gives a thousand times the power of burning hydrogen?

RM: On average we are going down to the (1 over 10) to the (1 over 20th) level of hydrogen. So we'd have a hydrino say (1 over 15). That would be the quantum number that goes into the Rydberg formula to describe its binding energy. That is the energy it takes to remove the electron. Actually this formula goes back to the 1800s, 13.6 over n-squared [$13.6/n^2$].

All the energy levels of hydrogen that are spontaneously radiative fit that formula where the n is 1,2,3 etc.—an integer.

AR: Again, we're talking mathematics

RM: But, this is important to understand, because you are talking about the size and I'm talking about fractional quantum numbers that go into the energy formula are the same fractional numbers that describe its size relative to hydrogen.

AR: So the container that you have, the stainless steel container....

RM: You can use stainless steel, yes. You can use molybdenum, or tungsten, or stainless steel. You have to run this at very high temperatures, so you need something that will run at high temperatures. Stainless steel is pretty good.

AR: Would you use a ceramic?

RM: No we'd use either molybdenum or tungsten.

AR: Tungsten can stand very high temperatures?

RM: 3,000 degrees centigrade.

AR: So, does it happen that the container heats up to temperatures like 3,000 degrees?

RM: The container that we have, the one we have run, we had a center line of 2,000 degrees C and the outer stainless steel part of it was 850 degrees. But the one we're designing now, the container wall itself will be at 2,000 degrees.

The container that we have, the one we have run, we had a center line of 2,000 degrees C and the outer stainless steel part of it was 850 degrees. But the one we're designing now, the container wall itself will be at 2,000 degrees.

AR: That heat is taken off by....

RM: Heat exchangers and then it can be used in a gas turbine. And the gas turbine can be used to turn a generator, or generate motor power. Standard conversion.

AR: OK, if you've got heat, there are ways to produce electricity?

RM: Yes, this is a cheap way of making heat.

AR: You continue to feed in hydrogen and does all the hydrogen you feed in at a controlled rate come out, change to hydrinos or just a fraction of it?

RM: A pretty large percentage of it.

AR: But the rest would tend to flow out the chamber right?

RM: What we feed in there ..... we've done batch studies where you put in hydrogen and leave it in there till the reaction stops. So all the hydrogen in that cell is eventually consumed to make hydrinos.

AR: I see. And you just let the hydrinos go.....?

RM: They diffuse out eventually, yes.

AR: Eventually, can the process run continuously?

RM: It can run continuously, yes. We've done that. Where you feed in new hydrogen.

AR: At a controlled rate, just as fast as it's needed?

RM: So you have very low mass balance... because you get a tremendous amount of energy per atom so you don't need very many atoms.

AR: Right, I understand. Then the next step is to get efficient use of the heat that's produced and engineers have worked at that for a long, long time.

RM: That's correct, we are working on that now. There are a lot of really interesting technologies to which this lends itself. One of the things we're looking at—we're looking at a couple of scenarios. Of course, there is retro-fit of central power plants, where you just take the existing boiler and you put in our gaseous reactor that converts hydrogen to lower energy hydrogen and generates power large-scale and turns either a gas turbine or a steam turbine to make electricity.

The other scenario is that we would look at distributed power, or we make maybe one-megawatt units and we put the little power generators out at the locations where you have sub-stations today and then they would generate power for, say, 200 homes or several businesses.

AR: Assuming, water is available, does the water have to be specially pure?

RM: No, any kind of water will do. As long as it's water that has hydrogen in it. Heh, heh!

AR: I lived 12 years in Paraguay and I've been in other countries, Cuba for instance, which is much, much more advanced than Paraguay.

RM: Yes, I'd say so, they're kind of having some economic problems right now, but you know more about that than I do.

AR: They had severe economic problems three or four years ago, they are pretty well over that.

RM: That's good news.

AR: It's great and everybody is educated.

RM: That's a good point.

AR: Everybody can read and they would jump on this energy system!

RM: They're probably in need of energy, especially since the Russians kind of cut back on their supplies.

AR: Right, they've been thinking of finishing this nuclear power plant that was started by the Russians.....

RM: I'm afraid they don't have the technology.

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AR: They do need energy and they have energy, but nowhere *near* what they need and I don't know if you'd be, at what point, maybe not now, but at some point, you would be willing to allow Cuban scientists to come here and.....

RM: Well, I'd have to look into that. I think there's some export restrictions still.

AR: Oh yes, export you can't...

RM: On a scientific basis, I could talk to them. Export -- I think there's still restrictions.

AR: I've got the Government restrictions here. I've got the Treasury Department stuff and there's huge loopholes, you know you could fly a Cessna through the loopholes. What's prohibited is doing business. Every other country can do business with Cuba, but we can't.

RM: So you could probably do business through the other companies in other countries.

AR: If you are established with any other country you have no problem. But scientists, can scientists come here and learn everything and do the work there, but maybe not be able to pay you. That might be the problem.

RM: Yes well, not that we had patents in Cuba anyhow, I don't think they're PCT signatories. Anyhow, have you got any more questions?

AR: Yes, I have lots of questions. The thing that surprises me greatly is that the military of this country hasn't come down on you and said: "This is a military secret."

RM: Well, I think it's still controversial. I think in time the military will see some applications to it, but right now we aren't working with the military. We don't contemplate it at any time in the near future. We're just working on developing it as a new civilian type of energy source in a business perspective.

AR: I've heard rumored, I don't know the facts, I heard rumored that some other inventions have been concealed in that way.

RM: No this one hasn't.

AR: Right. And from what I understand, from what you've already told me, when the patent is published here, presumably anybody could view what you are doing?

RM: That's correct. Under license they could.

AR: But to be legally doing it, it would have to be licensed?

RM: That's correct.

AR: But the information would be out there and if they chose to do it illegally, you couldn't stop them except by suing them.

RM: That's correct.

AR: But, at the same time, it's clear that ultimately it will be possible for the people to have it, whether big corporations do or not?

RM: Yes, we're working on these two distributed power schemes—personal units. You'd have one for your home, you'd have one for business and office and the other one is clustered—what they call distributed power and that is when you have a unit, say at the sub-station, which may feed 20 businesses or 200 homes, this is the megawatt unit which will feed up to 200 homes.

And then the other form of individualized power that I like the best, for the long term, is that an automobile could have a generator that could generate about 100 kW electric and there are 10 million new vehicles made a year which would give you a thousand billion watts. Now the total electrical generating capacity of the United States is only 600 billion watts. So every year you have new cars coming off the assembly line, and when you park your vehicle you would plug the wire into the grid and it would generate 100kW electricity and you'd be paid for the electricity.

AR: And what that means to me, and it would mean to other countries is that one vehicle in a village could supply power for the whole village.

RM: Yes that's correct. In fact, 100 kW is a lot. 100kW could heat about 20 homes, American homes.

AR: So it means that you'd have a mobile power station and one could drive out to every village in every country of the world.

RM: Well, if you look around at the parking lot—you go down to Philadelphia—people have $20,000 to $30,000 dollars investment in [their] cars and it's not making them any money. They are using them 3% of the time. They park in a garage or in a parking lot. You'd have a strip running down the parking lot to put the cars in and there's a system already that will recognize which car it is and give you a credit, while you are selling juice back to the power company and when you use this electricity you'll get a debit.

So electrical utility in the future will be more or less like a re-seller of power. You can generate more than $10,000 worth of electricity with your car and you could do that today if you put an electrical generator on your car. The problem is that the gasoline would cost more than what the coal cost to make the electricity. It would make so much pollution, we'd all die of carbon monoxide poisoning.

This could make that happen. It's all in place, I mean the power conversion equipment, you can step up the voltage, step down the voltage, change the frequency—all that's in place.

AR: I know all that stuff.

RM: The computer technology to handle all the debiting and crediting and...

AR: My question is this...how long will that power plant hold up, before one or more of the parts deteriorate from the heat and have to be replaced?

RM: Well, that's a good question. Those questions are things we have to answer. There aren't any moving parts, so it should be possible that that shouldn't be the weak link. Now, if you do look at the next weak link, the turbine—mini-turbines. They will run a phenomenally long time. At least for motor power applications. Capstone [Corporation] for example, is looking into putting turbines in to replace internal combustion engines using fossil fuel. And, those turbines should last a lifetime. Turbines run for an extremely long time.

Your next question was about electric motors. Well, electric motors are very, very resilient also.

AR: My question is what about your generating system for producing the heat, how long will that hold up?

RM: We don't see any problems with it being a weak link in the technology.

AR: That answers my question. So the stainless steel system, which is the cheapest that you've mentioned, could hold up a lifetime and not get burned out, corroded...

RM: Well, we are working on that, but we don't see any problems with that kind of thing.

AR: OK, so that's a developed field that would hold up?

RM: And there's no moving parts in that. You have the heat exchanger, the vacuum vessel. Then we have the electrolyzer and for the amount of hydrogen we'd have to electrolyze. For example, a tank of water would would be worth a thousand times the energy of burning hydrogen—which we are seeing in the lab now and we have

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that independently validated. The tank of water could run a 200 HP automobile going 60 mph and a tank would take you 100,000 miles.

The electrolyzer doesn't look that that's going to be a weak link either, it doesn't need to run much hydrogen.

AR: I was going to ask the question how airplanes would work on this?

RM: Well, they'd probably use a turbine engine, but you'd have to make a very high powered and very compact heat exchanger and the same way the gas turbine would work in the automobile you'd have a gas turbine in the airplane.

AR: This is just a total revolution for the planet.

RM: It is, it represents an unbelievable....if you are going to design an energy source, you couldn't design anything better.

AR: Exactly.

RM: Because the planet is essentially made out of water, you would use very little, and the amount you would use up would take thousands and thousands of years just to remove the water from the biosphere that the burning of fossil fuels put there in the first place.

AR: We wouldn't have to worry about the water situation—the oceans are full of it.

RM: Plus you've got billions and billions .....inexhaustible.

AR: My operation is a shoestring operation. Somehow if I work for the universe, the universe works for me. I have an income, from a trust my mother left of about $12,000 a year, and I have a family of four and people say, "How do you run an airplane on that income." Well, people donate. You know, we got a $1,200 radio in the airplane just recently donated by ICOM. And I'm looking forward to a donation of a good GPS [global positioning satellite receiver] and there are various people who are interested in what I'm doing. When they read about this, they donate more.

This means everything. I'm observing the planet in ways that they are not able to do at this time and people appreciate it and they help me.

[This is the end of the personal interview, then AR took some pictures and now here is another phone call with Dr Mills. After the in-person interview, I called Randy Mills again:]

RM: Oh, how are you doing, Art ?

AR: Better and better, except I just learned that there's an air-worthiness directive on my old Cessna [airplane] and that's going to cost me over a thousand dollars.

RM: Oh, God I hate that.

AR: Do you fly ?

RM: No, I was just being facetious.

AR: The reason I'm calling you is to try to get you to just tell me the story of how you discovered this new form of energy.

RM: OK, I was working on the theory, you know that theory, I gave you that book, and I applied that non-radiative boundary constraint to the hydrogen atom.

AR: What led you to work on a new theory?

RM: Well, because I knew the old theory was wrong. It doesn't work. It causes a division between classical, you know, the large scale physics, and atomic physics. And Bohr, back in the early 20th century said he couldn't get the theories to work out and be in agreement with classical theories, so he just said it just obeys different physics, which was a very bad move. And we've inherited that ever since. So what I said is physics has to apply on all scales, because everything is made out of atoms and the laws that apply on the large scale must apply on the atomic scale. It's just that since they did not solve the equations correctly.

AR: Did that lead you to this electrolysis experiment?

RM: Yes. So what I did was I went back and I solved the atom by invoking a constraint— in other words, whenever you solve the atomic equation you have to have a condition to solve it, a constraint. There is an infinite number of solutions to the wave equation. So I picked as my constraint something that you'd observe all over the universe, that is hydrogen at the 13.6 eV energy level, is non-radiating. So I said I will solve the atom with the constraint that it doesn't radiate at that energy level. And the atom solved in closed-form without any postulates or fudge factors or added-on junk that they have today. And it matched all the various measurements that have been made on the hydrogen atom which permitted me to solve the electron, that is the free electron, the photon, excited states of atoms, and it also predicted that there are these other low energy states of hydrogen that involved transitions without the release of radiation.

AR: What you are saying is that you started out then from the mathematical point of view?

RM: A very sensible theory—derived the solution to the atom, it predicted these other states of hydrogen and how to make these transitions occur. That is, I had to use a catalyst that would absorb the exact amount of energy 27.2 eV and I looked in the literature and said, "Oh, look, potassium has a reaction that can absorb that amount of energy." And then I ran the reaction. Simple as that, it's all from theory.

AR: I see. You started out to be a *medical* doctor, is that right?

RM: Yeah, but I invented a lot of cutting-edge technologies and I was always in the high-tech end of things and I took an electrical engineering program at MIT simultaneously.

AR: We know that. I see that in your biography.

RM: Then, that's why I picked up on this non-radiative constraint from one of my professors who was working on free electron lasers. Then I applied that to the atom and solved the atom correctly. And by solving the atom correctly, I found that there are these other states of hydrogen that could exist and how to make those states in a reaction.

AR: How come if the normal state of hydrogen as we know it has more energy, how come that so much of it exists at the *higher* energy level?

RM: Because that is the first non-radiative state. That means you can't get it to go to a lower energy unless you take energy out of it by a non-radiative mechanism. In fact, normal molecular hydrogen forms without emitting light also. It has to have some third body take away the energy, namely the bond energy, for molecular hydrogen to form. So it's the same principle. In fact, if you look over the entire universe, you'll never see light being emitted from molecules forming from atoms of hydrogen.

AR: With other atoms, that happens?

RM: Well, I don't think it happens with any atoms. I had a chemist in here the other day and he said, "You know, I think that's true of *all* atomic reactions that form molecules. I don't think there are any of them that emit light. That they have to have a third party. You know in molecular reactions."

AR: So, you started out as a medical doctor working at the high-tech end of inventing new medical procedures.

RM: Not procedures, new medical tech-

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nologies. Pharmaceutical technologies and medical imaging technologies, things of that nature. And I was working on *theory* to predict new technologies and I went back and I re-worked atomic theory correctly. And it predicted this new source of energy by making a form of hydrogen that exists in nature, but no one knew how to make it or was aware of its existence.

AR: So hydrinos do exist naturally?

RM: Yes, they make up the dark matter and they—it accounts for part of the energy, about 40% of the energy coming from our Sun, for example. It accounts for the flares that you see in the Sun.

AR: Flares?

RM: Solar flares. The mechanism behind that is these lower energy hydrogen transitions.

AR: Tell me something else. Some people who claim to be scientists, although I don't know if they really are, say that it isn't possible for people or animals to get all the energy that they have simply from the oxidation of food; that there must be something else that goes on in the body that gives us our energy.

RM: Hey, I'm not sure about that. Well, if you get me some literature. I mean I've never looked at—I know you can put people inside a closed chamber then you can feed them and figure out how much chemical energy is there and measure all the heat they give off, etc. I don't know. I've never looked at that data, maybe they're right, maybe they're wrong. I'd have to look at the data.

AR: What I've seen of it isn't scientific enough to...

RM: It's probably not accurate enough to tell. So, you really can't comment on it then.

AR: Right. My theory is that if you took all the food that someone ate normally and burned it in pure oxygen you'd get a certain maximum amount of energy from it.

RM: That's correct, from thermodynamics.

AR: Then if you took the work that that person does physically and determined how much energy he puts out, if he's putting out a lot more than you can get by burning the food, then he must be getting it from some other source.

RM: You could do that experiment by putting him into a closed environmental chamber and seeing how much heat his body releases.

AR: Right, but I mean the heat is minimal compared to the physical work.

RM: What I'm saying is by moving things around, that mechanical energy has ultimately got to be converted into heat.

AR: So, you were working at inventions having to do with medicine and healing and you came upon...you started working on the mathematics.....

RM: Of atomic theory...

AR: Of atomic theory, and finding that the theory was evidently wrong.

RM: Yes.

AR: And it's not only your discovery but other people have seen so many inconsistencies.

RM: That's correct.

AR: That you had to say there must be something wrong with this whole mess. Einstein saw that.

RM: Yes, Einstein saw right through that at the very beginning.

AR: And he said that his theory was, at least, not complete.

RM: He was correct though. His part of it was correct and his intuition was correct, but he couldn't finish it. I think I've finished what Einstein's dream was.

AR: Right. And yet—but people seem to doubt—so many other scientists seem to doubt that hydrogen could have a lower energy than what they call "the ground state."

RM: Well then that's OK, because this—you know—is something that's really quite new and it's been ingrained in them that there is something called "the ground state," and the reason they're ingrained with that ground state is because that's a postulate of quantum mechanics in order to solve the hydrogen atom.

In other words, the theory— they invented the theory to match what their conception of the hydrogen atom was; it dates back to 1886. Because they had some data that said here's a hydrogen that goes into this lower state, so we'll make a wave function that has that as it's lowest state, but it didn't have any physics built into it, it wasn't based on physics, it was just a mathematical model. It didn't have to do with physics. Because remember they said that physics was different on the atomic scale.

AR: Right.

RM: So people have been taught that 13.6 eV is the lowest, or the ground state of the hydrogen atom, but in fact it's not, there's no reason why it can't go lower. In fact, the potential energy between the proton and the electron could release a million extra electron volts of energy. And it *doesn't* and you ask, well why can't it go to these lower states, because it does it spontaneously when you form a molecule of hydrogen, it goes to the lower states when you form water? The reason it doesn't is because that's the first non-radiative state and that's the condition I used to solve the atom correctly. Do you follow me?

AR: Well, more or less.

RM: Well, let me put it this way. Around 1900, scientists said well, we've got some spectra that we see hydrogen has this state that we feel is the lowest energy state. So what we're going to do is we are just going to make a mathematical—we're going to describe the hydrogen atom. The same way you would use words, they use mathematics. They said the hydrogen atom is 13.6 over n-squared [n^2], where n can't go below 1. They just proclaimed that. Didn't have anything to do with physics, just proclaimed: "That is the ground state." And what I did, is I said, "*No*, it's physics! If you go back and solve the problem from the principles of PHYSICS, the electron can, in fact, go to low energy levels and you just haven't FOUND it yet."

So, if they found the hydrogen in one-half state, they'd just say, "We *proclaim* that

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hydrogen can be 13.6 over n-squared where n is one-half, one, two, three, four, five—you know, up to n is infinity. They just found it in that state and they just said we'll proclaim it. Now, you can describe it in words, or you can describe it in terms of mathematical formulae, both mean the same thing. You follow me ?

AR: Yeah, I follow you, without the math, I'm not that good at math. Physics is a hobby of mine. I...

RM: Well, all I'm saying is that they found hydrogen in a certain state and whether you describe it in words or in a mathematical equation that is equivalent to words, they just said: "I proclaim hydrogen is—and they set this out—said that's what it is. And what I'm saying is if you solve it correctly from first principles of physics, it says that is not the end of the story and that is not the full description of what hydrogen is.

You have these other states that you can cause to happen by a non-radiative mechanism. And that's what I did, I solved that and I went into a lab and tested it and it made energy and then I did some experiments that showed that this new form of hydrogen exists, and then I looked in the literature and alas there is a ton of data in the literature that supports the existence of this new form of hydrogen and explains many, many problems that before could not be explained.

AR: You say there's a ton of data in the literature?

RM: That's correct.

AR: But have you got specific literature in mind.

RM: Look on the web page, **[www.blacklightpower.com]**. There's a ton of it, there's things from solar flares, there's light from interstellar media, there's transitions in the solar corona, there's microwave background from deep space, there's been nuclear hyperfine transitions, there's proton atom scattering, that shows a back-scattered electron peak that has the characteristic feature of being caused by a one to one-half fractional hydrogen transition. There's a lot. But look, my wife's waiting on me. I've got to run home now. Well, ring tomorrow if you want to talk some more.

[The final phone interview: June 19, 1997]

What led to the discovery?

AR: I want to ask you a bit about your life and what led you to take on the career that you took on ?

RM: O.K., I'll have to think about that.

AR: Naw, you really know it all.

RM: Yeah, sure.

AR: I mean you might want to think about what you tell me — sort of informal — I don't want a whole bunch of details or anything.

RM: OK.

AR: If you could tell me a little bit about how you came to be in that situation—that you wanted to be an inventor. I wanted to be an inventor too, but when I was a teenager I discovered that most of my inventions would be used by the military, or something .

RM: Well, I just decided that's what I wanted to do, and I just stuck with it and did it, to put it succinctly. You know, like a person would want to be a doctor, or a lawyer, or a dentist. You just work through all the issues, and just keep focused and do it.

AR: What led you to want to be in that field?

RM: I enjoy it. It's like anything. If you try tennis and you like it, you try and do it as much as you can, and I decided I wanted to do it as a business.

AR: Did you have any medical problems in the family or things that led you to go into that?

RM: Not really. I just decided that was what I was interested in.

AR: As an inventor, or as a healer?

RM: All of it's the same to me, whether you're inventing medical or inventing energy. To me there's no such thing as a specific discipline. I think that's kind of an artifact of just the way the educational system is. But I don't see any sharp boundaries between medicine and energy and physics and electronics or anything. I think they're all interrelated.

AR: All healing is a matter of healing the planet.

RM: Everything's interrelated. Sure, I mean the chemistry that goes on in molecular biology—some of the concepts can be applied to atomic physics to cosmology. I mean, they're all basically working with similar types of reasoning processes.

AR: How old were you when you first decided that you wanted to be an inventor?

RM: I started working when I was, like, six.

What is the Aquarian Research Foundation?

(Finding ways to a positive future for the earth since 1969)

by Art Rosenblum

About sixty years ago a young schoolboy asked his teacher, "What is the purpose of life?" She said: "The purpose of life is to have the highest possible standard of living." He was dubious.

Some years later at a small Christian college in Ohio, he asked fellow students, the same question and was told that no one, not even the professors could answer it.

Then at a Quaker meeting Art heard of 600 people in Paraguay, South America who lived together, did not go to war or work for money but shared all property. He sensed those people might have an answer, and asked the college dean who replied: "A year at a place like that is worth more than a year at any college."

After about 20 years of voluntary poverty in that and other communities, and full time work for world peace, Art Rosenblum came to Philadelphia with fifty dollars to learn how this planet could have a positive future. Thus began the Aquarian Research Foundation. Lawyers volunteered for a tax exemption in 1970.

Aquarian, has no corporate or government funding so is free to search in all directions. Science and aviation are Art's hobbies. He flys a 1958 Cessna to where new things are happening, even to certain Carribean islands when necessary.

For years he sought answers to the energy problem. Arthur Young, inventor of the Bell Helicopter financed a cross country trip to check on one but it was a fraud.

In Paraguay, Art made electricity from charcoal gas. He saw many marginal solutions like wind and solar. He's an inventor type himself with a patent that makes it easy to land aircraft, but he has no time to market inventions because his real passion and unpaid full time work is a positive future for the entire planet.

Judy joined him in 1976 and, working together they raised two children, a writer/editor at 18 and a computer whizz nearly 13, who's also a prize-winning writer. Still they live on a shoe string and depend on miracles to keep going.

Computers, parts and maintenance for the Foundation's 1958 Cessna, automobiles, even some telephone service is donated by people and companies that understand the need for future research and want to keep it going so new discoveries as positive as the work of Randell Mills will not remain hidden from public view. Concerned people who provide those miracles receive Aquarian's newsletter about 10 times a year and tax write-offs from IRS.

Subscriptions to Aquarian Alternatives are $25/12 issues. Sample copies are free with stamps and a return label. Other articles, audio and video tapes are also available as well as the actual taped interviews with Dr. Mills.

Aquarian Research, 5620 Morton St., Philadelphia, PA 19144-1330 is for letters. e-mail is <artr@juno.com> and phone is 215-849-259 or 849-3237 day or evening.

We may be away most of March, so February is the best time for contact.

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AR: Really?

RM: Yeah, pretty young.

AR: With what kind of things?

RM: I wouldn't want to mention—they were pretty far out. I think we ought to stick to the things we actually got working.

AR: I see. Someone wrote the following: "For the sake of argument, let's accept that this is true (meaning BlackLight Power works). What are the plans for this wonderful new energy source? Is it to be held in the hands of Dr. Mills, who would surely become the richest man in the world overnight, if it were, or, is Dr. Mills beholden to some corporation or consortium, or, are there plans to make such wonders available to all, like the air and sunlight that surround us as a right of mankind?"

RM: Ah, well, that's kind of a Utopian dream, but the realities are, when you commercialize something, someone's got to pay for the hundreds of millions in development costs, the infrastructure changes, and it's got to be organized as a business. You know, penicillin wasn't developed, except by the military, because it was "given" to the world and then no one could get patent rights on it, so no one wanted to spend the money to develop it, because they couldn't derive any revenue from it. So, I've got shareholders I have to answer to, and corporate investors and the like. But, if you believe in the free market system, if it's the best energy source, everybody's going to get it at the cheapest price. That's basically the way the system works. And I think it is competitive to coal and gas and nuclear power. And, in time, you're going to see everyone's standard of living come up and the environmental issues improve as a consequence of the introduction of this technology and adaptation of it.

AR: Right.

RM: If you're asking, I've got about 160 shareholders. It's a private corporation, but we're intending to take it public, which means that anybody can buy ownership in the company, in other words anybody off the street could own shares in it if they had the money to buy the share price, and the units it will be in, it will be relatively affordable to anybody.

AR: Any idea when that might go public?

RM: We're trying to get it done in 18 months. I mean that's kind of the business plan, but we can't guarantee anything.

AR: Right, but in the meantime do you expect to have a powerplant running ?

RM: We're working on prototypes, you know, on the cell itself and also on—the prototypes on the cell — we're looking at conversion equipment right now. We're trying to do some research into that, what would be the most effective conversion equipment.

AR: To convert the heat to electricity?

RM: Yeah, it looks like maybe turbo-generators look like to be the forerunner right now, but that could change.

AR: And are you working at all on mobile systems yet ?

RM: Sure. Yeah, as a matter of fact there's some real good synergies between the mobile and distributed applications—the equipment required—so there could be shared development costs and increased markets, that type of thing.

AR: What about the poor countries—presently poor countries of the world—where they have no electricity? Would you see this as being made available at a price people could afford in those places ?

RM: It's probably the only thing that would really work for those countries, because they don't have the infrastructure for fuel and they don't have any central grid, and they don't have the economy to put any of that in. So deriving the hydrogen from water from part of the energy of the process, and then having a small compact unit that's relatively simple, is probably the *only* solution for them. In a lot of countries I think this would be very, very beneficial.

AR: Right, I can see that. As I said, I've lived 12 years in the jungles of Paraguay and the remarkable thing is....

RM: You don't have any fuel, you don't have any wires, you don't have any engineers there, so if you can just drop in, parachute in a self-contained unit that's relatively simple — you know the advantages of that.

AR: Where I came to was a Christian cooperative community of 600 people and they had a couple of engineers, and they had steam engines after 8 years there, and they had electric light all through the village, whereas the Mennonites who'd been there for thirty years already, could not do it because they would have had to have electric meters in every house. And the cooperative community didn't have to worry about that because nobody paid anything.

They had electric light. It was a very impressive sight, the night that a Mennonite brought me first to his home a few miles away and I looked in the direction we were going and there was a glow in the sky which wasn't the Moon, and I said, "What's that ?" He said, "Oh, that's Primavera. They have electric light."

RM: Wow !

AR: It was very impressive !

RM: Yeah,

AR: So, I got there and they had these ancient steam engines, and the newest one was from 1905 or 1913, the German Wolfe, but the old one was from 1898, and still running! And we built a charcoal gas engine system to do it a bit safer. Anyway, the other question is that an engineer that I was on the phone with, who works with a lot of physicists in the field of cosmic rays—and I mentioned to him that I thought you said that hydrinos could capture the energy from a cosmic ray and revert to hydrogen atoms.

RM: Yeah, but that's a rare event.

AR: A rare event, but he said cosmic rays are essentially protons, for the most part.

RM: Yeah, but if they smash into a hydrogen atom, they can knock the electron loose. Hydrogen or lower energy hydrogen. I don't think anybody would refute that. No matter what the electron is, a cosmic ray will ionize anything. They're very high energy. So they just smash into something and rip the electron loose.

AR: So, it would not restore it to a hydrogen atom?

RM: Yeah, it wouldn't, but once you ionized it, then the electron would be captured by—see, you'd have a free electron and a free proton then, and of course it would form a hydrogen atom.

AR: So that could actually happen. But it would be a rare event that we don't have to really worry about.

RM: Well, no, it would be a good thing, right, because then it would block the cosmic ray somewhat, and it would just revert back to normal hydrogen, so it wouldn't screen some of the cosmic rays, albeit it's not going to have much of an effect, because there's not much of it, and the cross-section what they call—the chance that a cosmic ray will hit it, because it's real small—is low.

AR: Right. The other question—if hydrogen is not at its lowest energy state, how could there be so much hydrogen in the

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universe, and around everywhere at this high energy state?

RM: Everybody that I talk to has missed that. That's such a common question. You know, well, 95% of the matter that we see is hydrogen. Why isn't it in a lower energy state? Then you've got to point out to people that the 95% of the matter that you can see, that's hydrogen, that only represents 5% of the total mass of the universe, from what gravitational measurements have been made. So, what's this other 95% of all the matter in the universe? What *is* that? Well, that's lower energy hydrogen, also. I mean, that's hydrogen, but it's in a lower energy state. So, there is a lot of it, there is an awful lot of it in the universe in this lower energy state. You know what I mean, you're only seeing the tip of the iceberg.

AR: Right, so, is it also present in our atmosphere and everything?

RM: No, it's lighter than air, so it's not in our atmosphere, but it does make up a very large constituent of the mass in the universe, and there's a lot of it in the sun. It's being produced in the sun. And that's where a major fraction of the energy is coming from, by this transition reaction occurring in the sun. Namely, if you look at the spectra of the sun, there's a bunch of lines that haven't been assigned that match the Rydberg formula, which is the energy levels of the hydrogen atom, with fractions, rather than integers. That is 1 divided by I, where I is an integer, substituted for n-squared [n^2] in the denominator of the equation. That gives you very high energy levels in terms of the energy of the light coming out from these transitions. And that's seen from the Sun. It's seen from interstellar media; it's seen from solar flares, etc. So, it's just a matter of misidentification or lack of making the connection between spectra, a very large constituent of matter that could not be identified, and lower energy hydrogen. If they had made that connection, then they wouldn't ask that question. But, not till now has anyone done that.

AR: Caroline gave you a disk of the material on cold fusion that came in from the internet.

RM: Yeah, I don't really pay much attention to that.

AR: Right, and the problem [you say] is that they don't understand how the energy comes, where it's coming from?

RM: Well, I don't even know if they're getting energy. I agree there are some experiments done in very reputable labs that said they're maybe getting 10 or 20% heat from palladium and lithium electrolysis. And, it turns out that palladium^{2+} and lithium^{+} is a transition catalyst. So, you could get some hydrogen transitions, get some heat, and then the nuclear products. But, then, there's a lot of junk on there, talking about everything in the phone book—transmutating the periodic chart, a lot of really strange stuff that really isn't—I don't think —well done experimental work. You know, like, there's a company, CETI, and they were saying out at the Power Gen Conference [1995] that they had a device they could show in public that was making a thousand watts. And now, in the paper I looked at that you showed me, they are saying, "Well we may be getting 10 to 50% excess power." And that makes me really question their credibility. And they said they were getting a thousand watts with, like, a few milliwatts input, which is tens of thousands of times multiplier. And, now they're saying, well, we're only getting 10% excess heat. So, what happened in between? So, they really lose a lot of credibility, and you really trust what they're telling you as being accurate.

I haven't seen independent research labs saying that either, and that's the difference between us and those. Because we have top, credible labs saying, "We've independently tested this, we tried to disprove it, and it really does work." That's a big difference, rather than them, themselves, who are selling it, trying to raise money from investors, saying... "Yeah, we're getting a kilowatt," and then not getting anybody to independently test it, and then later saying, "No, we're not getting a kilowatt from a milliwatt in. We're really putting a kilowatt in and we're maybe getting a 10% excess energy on top of a kilowatt," which is really within the experimental error of measuring heat.

AR: When I read the stuff, I also saw mention of yourself.

RM: Yeah, they tried to latch onto what we're doing and pull us into that, but I don't encourage that. I condemn it rather than condone it, but there is a free press, and they'll do what they want to do.

AR: What they actually said was that you seem to have the best system, (and this was last year), but they thought you were secretive. And I thought, well, gee, you wrote this whole book.

RM: Right, I'm not secretive. And I published three papers— and I'm working with a lot of companies. It's just I'm not working with them, and I think they always put their spin on stuff to try to promote what they're doing. I don't put much confidence in what they're doing as really real.

AR: Well, I mean if you published this whole book that explains everything, it's hardly secretive.

RM: It's not secretive. You made a good point. They do try to put their spin on things.

AR: When they have no answer, they say it's secretive?

RM: Right. There, if I'm disagreeing with them, and I'm saying I'm not making a nuclear reaction, (and who would even *want* a nuclear reaction—they act like a nuclear reaction is a great thing). And I say, no, it's not a nuclear reaction, and then, because I'm not going along with them, they say, "He's secretive." Like it is a nuclear reaction, but he's not telling you. I think that's what they're implying. And that's absolutely not true.

AR: Right. And tritium production is one of the most dangerous things on the planet.

RM: Dangerous. Gets incorporated in your DNA, for example.

AR: Right, and it's impossible to contain it forever.

RM: Right. It leaks out, permeates through metals. It's a very dangerous stuff; gets in your water supply, and then you're stuck.

AR: That's what I'm hearing, too. I like what you're doing, because it doesn't involve that.

RM: Yeah, they say: "Oh, we're producing harmless tritium. And *without* radiation, nuclear reactions, and, "We have no radiation, we have no nuclear products." Well, I tell them, that's like saying that Sun Oil Company is cold fusion. There's a reaction that makes heat with no nuclear products, right, so that's cold fusion. Heh, heh!

AR: Well, yes, anyway, I really appreciate your telling me all this, and I think that's really what I wanted to know.

RM: OK, well good luck with your story.

AR: OK

RM: Talk to you later, good bye.

END of Interview

New Energy Times Archive

Randell L. Mills, MD.

Dr. Randell Mills, the founder and President of BlackLight Power Company, has a prestigious academic and professional record as a scientist and inventor. He graduated summa cum laude and Phi Beta Kappa in 1982 with a degree in chemistry from Franklin and Marshall College in Pennsylvania, and went on to Harvard Medical School, where he earned the MD.degree in 1986, conducted applied research, and filed patents on several revolutionary medical technologies.

Dr. Mills' graduate education also included classes in electrical engineering at MIT, which influenced him to examine certain problems with current atomic theory. Encouraged to focus his talents on invention by his mentor at Harvard, Dr. Carl Walter, professor of surgery and a prolific inventor and researcher in his own right, having founded over a dozen companies including four that became multinational, Dr. Mills went on to found his own companies upon his return to his home state of Pennsylvania. He has been issued numerous patents by the U.S. Patent and Trademark Office in such areas as medical imaging, Mossbauer cancer therapy, and drug delivery systems. Since 1989, however, he has devoted nearly all his energies to the development of what he has dubbed the HydroCatalysis process of liberating energy from hydrogen atoms.

Resumé

Dr. Randell L. Mills, M.D. Harvard Medical School, 1986; BA, Summa Cum Laude, Chemistry, Franklin & Marshall College, 1982; studied electrical engineering at MIT in 1985-86. He founded Mills Technologies in 1986 and HydroCatalysis Power Corp. in 1991. From 1986 to the present, he developed the following innovations:

• Magnetic Susceptibility Imaging (MSI)- a revolutionary body scanner that uses magnetic fields, an array of SQUIDS (Superconducting Quantum Interference Devices), and a mathematical algorithm which functions in concert like the visual system to provide high resolution 3-D internal vascular images.

• MIRAGE (Mossbauer Isotopic Resonant Absorption of Gamma Emission) a cancer therapy comprising a Mossbauer isotope derivatized DNA binding pharmaceutical and radiation which activates the isotope in situ to cause eradication of cancer with radiation doses of one millionth that conventionally used during radiation therapy.

• Luminide - a universal drug delivery molecule where intracellular drug release occurs when the prodrug reacts with cellular free radicals via a mechanism involving chemiluminesce, photochromism, and intramolecular energy transfer.

• GUT (Grand Unified Theory - the unification of the partial theories of chemistry and physics.

• BLACKLIGHT - an unlimited source of energy comprising the compositions of matter, methods, and apparatus to induce the electron of the hydrogen atom to undergo a transition to a lower energy level corresponding to a fraction quantum number with a concomitant release of heat energy.

VITAE

Randell L. Mills, M.D.
BlackLight Power, Inc.
Great Valley Corporate Center
41 Great Valley Parkway
Malvern, PA 19355

Date of Birth: September 3, 1957
Citizenship: United States
Education: B.A. Franklin and Marshall College - 1982
M.D. Harvard Medical School - 1986
Electrical Engineering M.I.T. 1986

Professional Experience:

1991—present: Founder and President of BlackLight Power, Inc.

1995—present: Founder and President of Luminide Pharmaceutical Corporation

1985—present: Founder and President of Mills Technologies

1973—1985: CEO and General Partner of Mills Brothers Grain Company

Special Awards and Societies:

Summa Cum Laude, B.A. Franklin and Marshall College
Black Pyramid Honor Society
Phi Beta Kappa
Willig Pentathlon Prize in Chemistry
Michael A. Lewis Memorial Prize in Physics
Isaac E. Roberts Biology Award
Rawnsley Science Award
Morgan D. Person Prize in Chemistry
Fredrick C. Schiffman Award in Chemistry
Theodore Alexander Saulnier Award in Chemistry

Patents:

MAGNETIC SUSCEPTIBILITY IMAGING (MSI)

PARAMAGNETIC DYNAMO ELECTROMOTIVE FORCE DETECTOR AND IMAGING SYSTEM. INCORPORATING SAME

MOSSBAUER CANCER THERAPY (3)

PHARMACEUTICALS AND APPARATUS PROVIDING DIAGNOSIS AND SELECTIVE TISSUE NECROSIS

METHOD AND APPARATUS FOR KINETIC MEASUREMENT OF ANALYTE CONCENTRATION

LUMINIDE CLASS OF ANTIMICROBIALS

LUMINIDE AND MACROLUMINIDE CLASS OF PHARMACEUTICALS (2)

ENERGY/MATTER CONVERSION METHODS AND STRUCTURES (2)

LOWER ENERGY HYDROGEN METHODS AND-STRUCTURES

A METHOD TO SEQUENCE DEOXYRIBONUCLEIC ACID

GENOMIC SEQUENCING METHOD

Publications/ Meetings:

"A Novel Cancer Therapy Using a Mossbauer-Isotope Compound," Randell L. Mills, Carl W. Walter, Lata Venkataraman, Kevin Pang, John Farrell, *Nature*, 336,787, (1988).

"On the Potentialities of Nuclear Gamma Resonance (Mossbauer Effect) Spectroscopy as a New, Low Dose Approach to Cancer Radiation Therapy," W.M. Reiff, R.L. Mills, J.J. Farrell, Proceedings of the International Conference on the Applications of the Mossbauer Effect, ICAME 1989, Budapest, Hungary - Sept (Hyperfine Interactions XXXX(1990).

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"Excess Heat Production by the Electrolysis of an Aqueous Potassium Carbonate Electrolyte and the Implications for Cold Fusion," Randell L. Mills, Steven P. Kneizys, *Fusion Technology*, Vol. 20, pp.65?-?81, (1991).

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"I knew the old theory was wrong. It doesn't work. It causes a division between classical— the large scale physics, and atomic physics. And Bohr, back in the early 20th century said he couldn't get the theories to work out and be in agreement with classical theories, so he just said it just obeys different physics, which was a very bad move. And we've inherited that ever since. So what I said is physics has to apply on all scales, because everything is made out of atoms and the laws that apply on the large scale must apply on the atomic scale. It's just that they did not solve the equations correctly."
—Dr. Randell Mills

New Energy Times Archive

The Referees of R&D

by Bennett Daviss

A profile of Eugene Mallove

Reprinted from the September 1997 Cover Story in ***Ambassador***, the in-flight magazine of **Trans World Airlines** (TWA), September 1997

Permission to reprint granted by author Bennett Daviss.

Inside a concrete bay in an industrial park outside Concord, N.H., Eugene Mallove huddles in his overcoat. Here in his private research lab, surrounded by water engines and hydrogen fuel cells—devices that hint at a future of cheap, clean, limitless energy—Mallove is waiting this chilly day for his furnace to be fixed.

"The fossil-fuel industry is trying to get everything out of us it can," he smiles grimly, "before we bury it."

He smiles, but Mallove isn't joking. Nor is he joshing when he declares that the laws of science need to be rewritten—not only the laws laid down by Einstein and other legendary physicists about the workings of the atom, but also unwritten laws that, he argues fiercely, violate science's own canons of freedom of thought and forbid researchers from challenging the accepted boundaries of knowledge.

Mallove's is the loudest public voice championing cold fusion, the star-crossed energy concept that flashed across the headlines in 1989, promising to liberate endless waves of cheap, clean energy from water. Most of the world's scientists long ago wrote off cold fusion as a bad joke. But Mallove and a handful of committed researchers around the world are collecting a steady drip-drip-drip of evidence that they claim confirms cold fusion's ability to generate power.

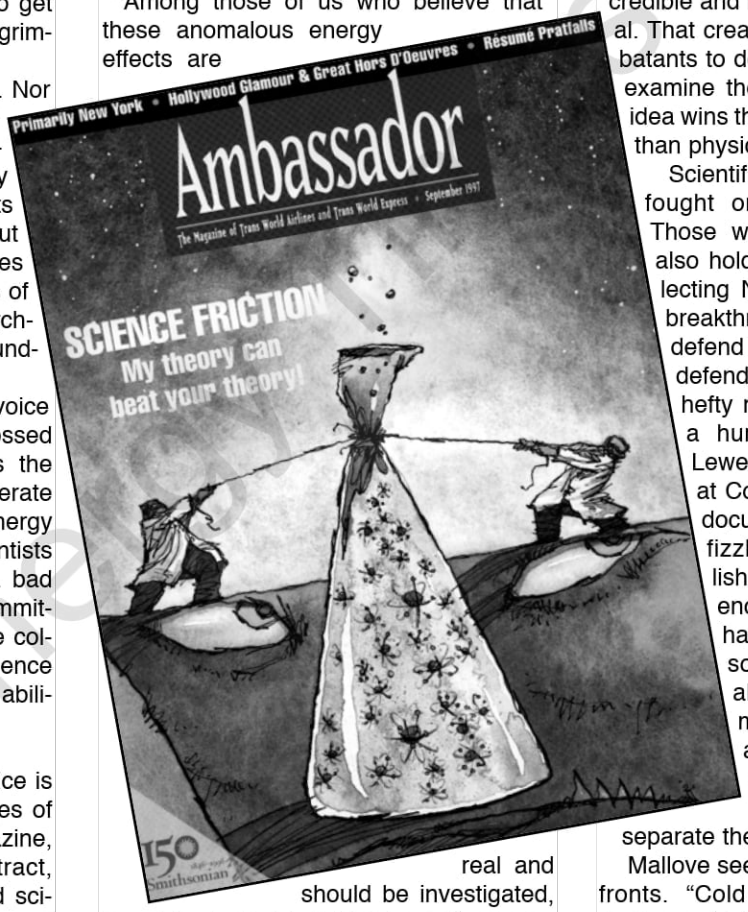
So why isn't science listening?

In part, it may be because that voice is often caustic. From the editorial pages of his bimonthly *Infinite Energy* magazine, part technical journal and part tract, Mallove denounces the distinguished scientists who still cast skeptical eyes on cold fusion as "hatchet men" and "members of the Flat Earth Society." Conventional physics is "due for a major overhaul," a repository of "rot and dogma" where "obvious, arrogant disregard for experiment has become the norm."

Even for the competitive universe of research science, those are strikingly contentious sentiments.

"Gene's role is to beat on the system, to be an annoyance, to be political," says Edmund Storms, recently retired after 34 years as a nuclear physicist at the Los Alamos National Laboratory in New Mexico. "It's not a role that scientists are comfortable accepting themselves, but it's absolutely necessary when a controversial new science is developing.

"Among those of us who believe that these anomalous energy effects are real and should be investigated, Gene is held in high respect." Storms pauses. "On the other hand, people outside the field think he's absolutely nuts."



Robert Park, a professor of physics at the University of Maryland and a noted cold-fusion critic, wouldn't use such strong language—but he wouldn't necessarily shy away from it, either. He snorts at the idea that Mallove might be a useful gadfly. "In mainstream science," Park says, "Gene Mallove is a joke."

Such inelegant discourse is as much a part of the fabric of science as are equations and test tubes. Truth in science is a dynamic equilibrium between those who want to stretch the bounds of accepted knowledge to encompass dazzling new possibilities and those who demand that those novel views be proven to be more credible and reliable than the conventional. That creative tension forces the combatants to defend their positions and reexamine their evidence. The stronger idea wins the right to define nothing less than physical reality.

Scientific contests are not always fought on fields of pure intellect. Those who paint new visions may also hold images of themselves collecting Nobel prizes or royalties on breakthrough inventions; those who defend proven truths also may be defending professional empires or hefty research grants. "Science is a human activity," says Bruce Lewenstein, a historian of science at Cornell University who closely documented cold fusion's initial fizzle. "There's a well-established role and tradition in science of people like Gene. You have people who carry on reasoned arguments, and you also have people throwing mud at each other. Debates are carried out at the scientific level and at the emotional level and it's often hard to separate the two."

Mallove seems to relish fighting on both fronts. "Cold fusion is not dead," he declares, "despite the best efforts of its enemies." He points to a score of research programs continuing in Europe, India, Japan and across the United States. "In thousands of experiments, credible researchers have immersed rods of palladium or nickel in water, charged them with electricity and observed not only the byproducts of nuclear reactions, but also have seen more energy coming out of the reactions than it takes to create them. The

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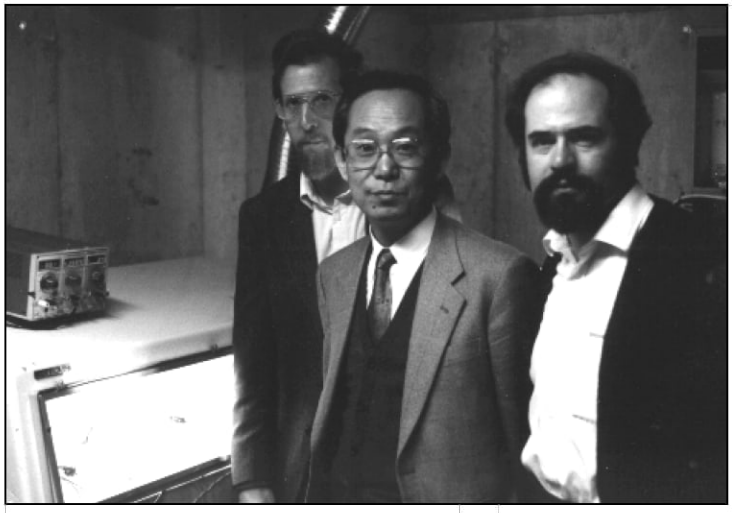


The Cold Fusion Underground—Literally! Dr. Eugene Mallove (R) with Japanese cold fusion researcher Dr. A. Takahashi (C) and Jed Rothwell (L) in 1992 in Mallove's then basement lab in Bow, New Hampshire.

evidence is overwhelming that this process yields more energy than it consumes."

If those results are accurate, atoms work in ways fundamentally different from how conventional physics has imagined: Nuclear reactions normally touch off incinerating temperatures and clouds of lethal radiation. So, to most trained scientists, the idea of cold fusion is simply an oxymoron. "If you're a normal scientist," says Douglas Morrison, a physicist for 38 years at the European Laboratory for Particle Physics in Geneva, "it's judged that cold fusion has been very well checked and all aspects studied" when the controversy first arose. "There's no more point in looking at it or thinking about it."

Richard Petrasso, chief scientist at MIT's Plasma Fusion Research Center, is more blunt. "The ongoing reports of excess heat and nuclear byproducts catch people's attention about as much as the occasional UFO report," he says. "I have better things to do with my time."

Like other cold-fusion soldiers, Storms knows that neglect of an idea can be more deadly to it than controversy. "There is excess energy coming from these reactions," he declares— "and Gene Mallove's essential role is to keep reminding everyone of that fact."

The Reluctant Radical

Mallove didn't plan to turn himself into a lightning rod. This aerospace engineer with advanced degrees from the Massachusetts Institute of Technology and Harvard University didn't expect to be cast out of mainstream science after a bloody public dispute with his alma mater's top physicists. This Pulitzer-nominated author of five science books and countless magazine articles, this first-name friend of science-fiction lion Arthur C. Clarke, didn't expect to become the voice of an apostate movement, rallying troops on a wild frontier of ideas.

Instead, Mallove expected to remain comfortable as an MIT public-relations officer and the institute's chief science writer. "It was a great job," Mallove recalls. "I'd probably still be there if cold fusion hadn't happened. "

But in March 1989, University of Utah chemists Stanley Pons and Martin Fleischmann convulsed science. The pair announced at a news conference that they had fostered nuclear fusion—the fusing of atomic nuclei, the process that fuels the sun—in a jar of water by immersing a palladium rod and charging it with a small amount of electricity, releasing far more energy than the process consumed.

> ***"Resources for research must be set aside to support work in unpopular and disturbing ideas.... That's how progress in science is made."-Mallove***

While scientists around the world set aside their current projects and attempted to replicate the "Pons-Fleischmann effect," others assailed the fundamental idea. Scientists expert in fusion reminded their colleagues that true fusion releases the heat of the sun, not to mention waves of lethal atomic radiation. "To these people, the fact that Pons and Fleischmann were still alive proved they were wrong," Mallove says.

Quickly, enthusiasm began to curdle. The Utah scientists were strangely difficult to contact. When they did finally publish a paper describing their work, the details were oddly sketchy. Their data on the experiment's production of gamma rays—a signature of nuclear reactions—was found in error. Meanwhile, the University of Utah asked Congress for a $25-million down payment on a major research program.

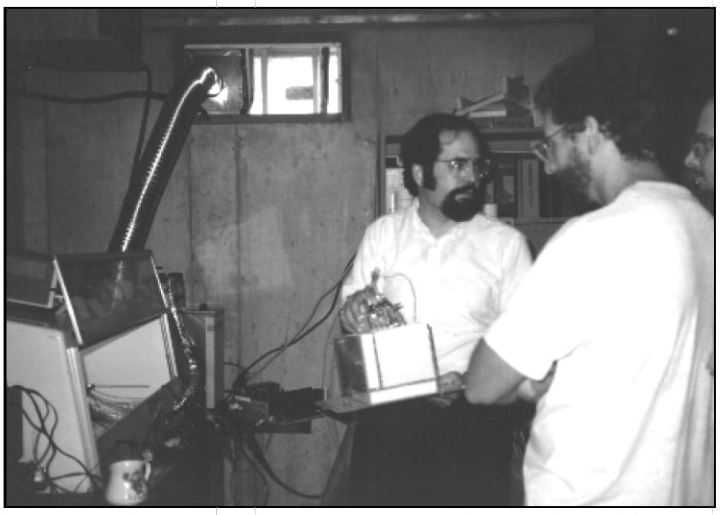
While Congress hastily convened hearings, results began to trickle in. Among the thousands of scientists testing the process, only a relative few could duplicate the results. Most found no consistently clear evidence of extra energy. More still saw no signs of atomic processes at work.

Four months after their triumphant announcement, Pons and Fleischmann had been hooted out of mainstream science. The majority's view of cold fusion was captured by Martin Deutsch, a physics professor at MIT. "In a word," he declared, "it's garbage."

But not to Mallove. In college, he'd specialized in investigating novel energy systems to propel space vehicles. "I was always looking for a faster way to the stars," he says.

As Mallove carefully documented the excess energy and nuclear byproducts found by a handful of scientists, MIT researchers launched their own attempt to replicate cold fusion. The controversy couldn't have come at a worse time: The institute was locked in a contentious negotiation with a skeptical Congress to renew its $30-million annual budget for "hot fusion" research. The decades-old project seeks—so far without much success—to replicate conditions inside the sun in order to fuse hydrogen atoms, liberate the energy binding nuclear particles together and demonstrate a practical new source of commercial power.

Within a few weeks, MIT delivered irs verdict on cold fusion: The group found no excess energy, no evidence of nuclear reactions. In an interview with the *Boston Herald*, an MIT researcher called cold fusion "scientific schlock" and accused the



Dr. Eugene Mallove shows heavy-water cold fusion apparatus used in the Mallove-Rothwell effort to reproduce Dr. Takahashi's excess heat results.

New Energy Times Archive

Utah pair of perpetrating a fraud.

Mallove, tending his growing file of positive evidence, believed passionately that his colleagues—particularly those struggling to continue the embattled hot-fusion program—were rushing to judgment. He touted the dozens of experiments that agreed with Pons' and Fleischmann's results, including tests at the Los Alamos National Laboratory that consistently yielded tritium, a byproduct of nuclear reactions. He pointed to fundamental mathematical flaws (which others also noted) in an article published by the prestigious journal *Nature* that many scientists cited as persuading them that cold fusion was bogus. Over the following two years, Mallove became increasingly strident in his views, clashing again and again with MIT's top scientists who'd long since dismissed cold fusion as a sour memory.

Then, in the spring of 1991, Mallove stumbled across the raw data from MIT's lone cold-fusion experiment. The data showed small but consistent indications that the lab's water cell had given off excess energy as heat. But in the published data, those indications had vanished. Mallove cried fraud; the scientists involved have long insisted that they merely adjusted their data for errors. "You never publish raw data," Storms says. "Instruments always produce some degree of error and you adjust the data based on mathematical analysis and your own intuition to make the results more accurate. But the experimenters at MIT adjusted their data to such a degree that they made disappear that which they were looking for because they didn't think it was real. That's not playing fair"—a sentiment shared by a number of scientists in and outside of the cold-fusion camp.

Mallove was not polite in his rejection of the MIT researchers' explanation. When one of cold fusion's most strident critics was invited to speak at MIT [*Ed. Note: This was Frank Close.*], Mallove crashed the meeting. He displayed MIT's raw and published data on an overhead projector, denounced the experiment and tendered his resignation— "probably about five minutes before he was fired," says one observer. [*Ed. Note—I resigned from the MIT News Office deliberately, not because of pressure. It was my protest against scientific fraud and arrogant attacks by senior MIT people against cold fusion research.*]

Mallove continued to make the case for cold fusion—first in his 1991 book, the Pulitzer-nominated *Fire From Ice*, an expose of what he regards as the scientific community's conspiracy to assassinate cold fusion, and now in the pages of *Infinite Energy*.

During its two years, the magazine has printed a technical paper by NASA scientists reporting excess energy emanating from a cold-fusion cell. It has aired theories by the late Nobel physicist Julian Schwinger explaining how cold fusion might work. It follows the ups and down of Japan's long-term, government-funded pursuit of cold fusion. Faithfully, it reports on the hundreds of experiments at the University of Rome, Texas A&M University and other institutions where researchers protected by tenure still brave the contempt of their colleagues to harvest sporadic excess heat, nuclear byproducts and other evidence that Pons and Fleischmann were right. (At one school, a world-renowned chemist was charged by his colleagues with falsifying his research results; after a full university investigation cleared him of all charges, a box of manure was left in his university mailbox.)

Unconventional Wisdom

For Mallove this fight isn't just about scientific fact. It's also about shattering the cultural strictures of science that, he believes passionately, imprison fledgling concepts with the power to explode conventional ideas.

> ***"Hope lies only in one direction," he declares—"the introduction of commercial products. On the day that a bona fide, self-sustaining cold-fusion device is marketed, the establishment view collapses in panic."—Mallove***

"Scientific judgments aren't made simply on the basis of information," notes Cornell's Lewenstein. "They're also based on the question of who someone is—especially if they're reporting something unusual. Can I trust them? Are they credible? It's a key issue."

That's precisely cold fusion's dilemma. The field lacks credibility; therefore, positive results are discounted automatically. "No one with credibility has said anything about cold fusion to make scientists revisit the subject," Lewenstein adds, "and the credibility of anyone working in cold fusion is immediately suspect."

New scientific ideas fall victim not just to the reflexive skepticism of schooled researchers, but also to the economics of the university. There are more people and projects competing for funding, lab space and other resources than can be accommodated. Professorships are equally precious, and those who seek them have learned that cold fusion can be a career-killer. "I'd certainly never vote to promote someone in my department who spent their time chasing fantasies," says Park.

A physicist at one major university (who asked to remain nameless) echoes the feelings of others: "There aren't many of us left in academia who think these ideas, when backed by solid data, should continue to be investigated. Virtually all of us have been driven out. If these ideas aren't kept alive now somehow, it might be generations before mainstream science allows itself to take another look."

Seeing no room for cold fusion in the house of science, Mallove has turned to the more open atmosphere of the commercial marketplace. "Hope lies only in one direction," he declares— "the introduction of commercial products. On the day that a bona fide, self-sustaining cold-fusion device is marketed, the establishment view collapses in panic."

To hasten the day, Mallove is attempting to catalyze the creation of an investment fund to buy equity stakes in the many struggling companies that are developing promising technologies. "We've already been in touch with several individuals with considerable experience in finance and they're interested," he says.

A Duty to Disturb

To Mallove and his cohorts, however, this is about more than just money. It's about academic freedom and the periodic need for science to challenge its own assumptions. "A portion of the resources for research have to be set aside to support work in unpopular—and even disturbing—ideas if those ideas can hold the attention of reputable scientists over time," Mallove contends. "That's how progress in science is made."

According to Michael McKubre, director of energy research at the private SRI International, a contract research institute formerly attached to Stanford University, "If there's a 1% chance that cold fusion could be an effective method of producing virtually unlimited clean energy, then we should be investing a significant amount of resources to find out how to do it—and in my view, the chances are very much greater than 1%."

Mallove savors the prospect—inevitable, he's convinced—that conventional science one day will be forced to agree. "Physics as we've known it is coming to an end," he says, eyes flashing— "and the world will be a better place for it."

Bennett Daviss contributes to several national and international magazines including Discover, New Scientist and Air & Space.

New Energy Times Archive

Cold Fusion Comix

—A new occasional feature. in *Infinite Energy* — A variety of humorous insights about the serious matter of New Energy, New Physics, and Scientific Heresy in general....

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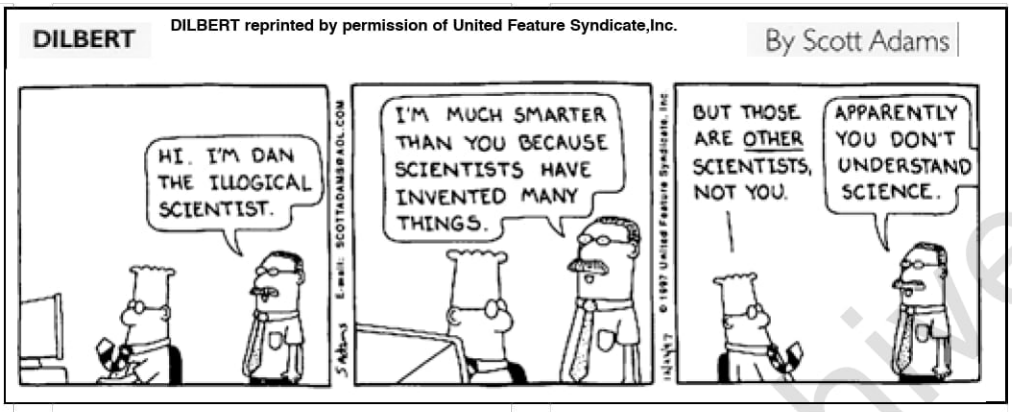
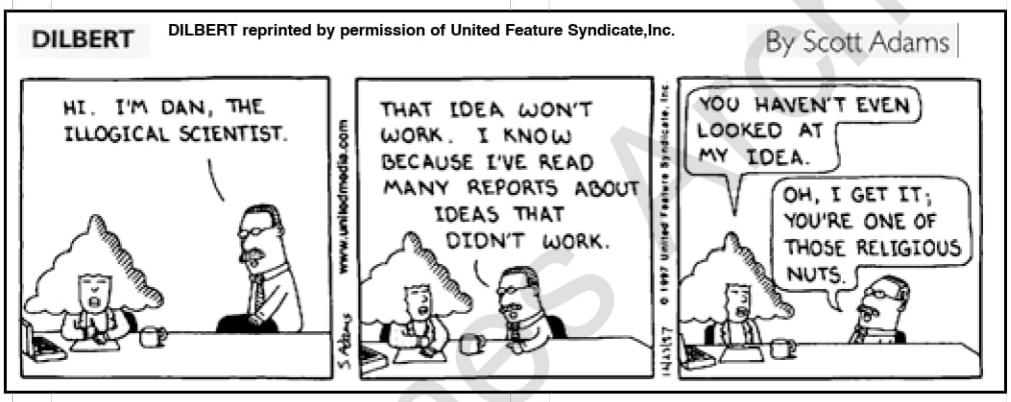
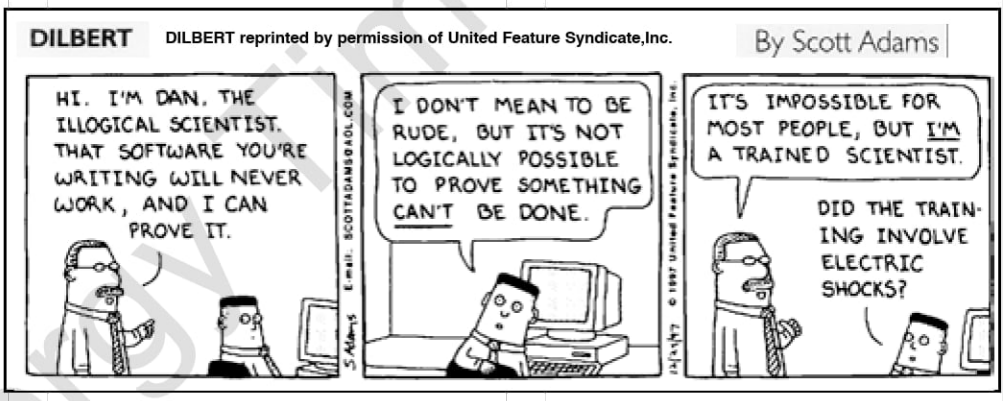




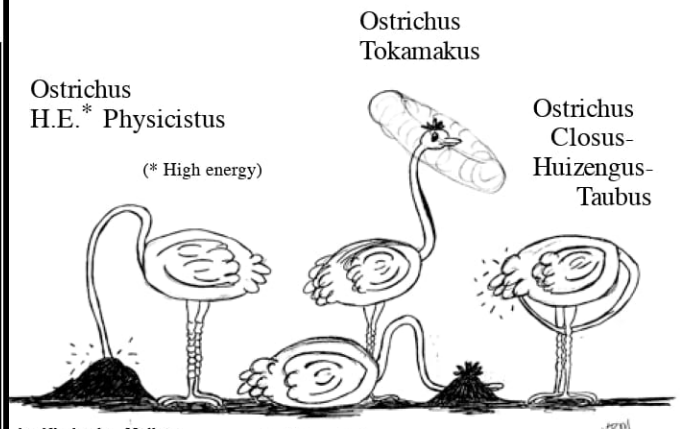


Stupidity is its own reward.
—Dr. Donald G. Carpenter

More Comix coming to this space soon...

Birds of a Feather in the Anti-Cold Fusion Bestiary....

Os-trich 3. One who is thought to emulate the ostrich's alleged habit of burying its head in the sand to escape from disagreeable situations.



by Kimberlyn Mallove, circa 1994, age 19, Gene's daughter.

Cartoon below by Gene Mallove's son Ethan Armstrong Mallove (circa 1994, then age 14.) *After Neil, of course!*

New Energy Times Archive

The Marinov Motor—A Brief History of Mine

by Jeffery D. Kooistra
4148 Kentridge Dr. SE
Grand Rapids, MI 49508
Phone: 616-281-8879, Internet: 75202,2023@compuserve.com, Member SFWA (**Science Fiction Writers of America**)

One experimental result, properly attained, should be sufficient to topple (or at least, modify) any applicable theory, no matter how cherished, no matter how long held, if that result is at variance with the predictions of that theory.

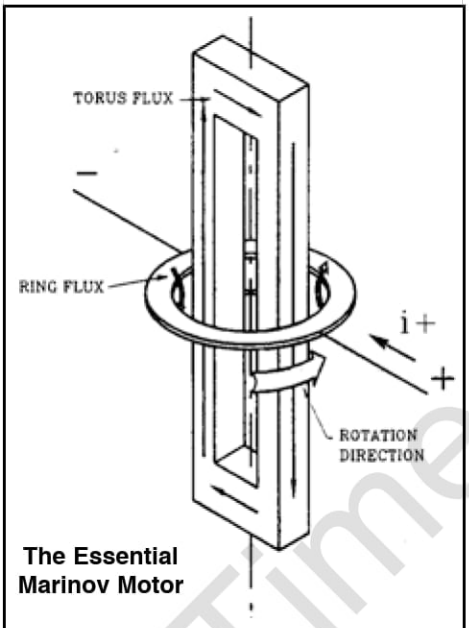
Fat chance!

As the Graneaus have pointed out in several books (l,2), the Scientific Establishment finds it far easier to simply ignore contradictory results than to take them into account, and thus, follows the path of least action. Though many experiments have been performed by the Graneaus and others which show that the "universal" Lorentz force law, a cornerstone of relativistic electrodynamics, is inadequate to account for all ponderomotive forces acting on metallic conductors, this fact is routinely ignored (or denied via specious experimentation) by the physics community at large.

The Marinov motor is another experiment that defies conventional electrodynamics. Those of you readers familiar with the cross product nature of the Lorentz force equation will appreciate the extreme heresy displayed by the Marinov motor in that the ponderomotive force applied to the rotor in this device is <u>not</u> at right angles to the direction of the current flow. Thus, the motor stands as a simple demonstration that all is not well with the world of electrodynamics.

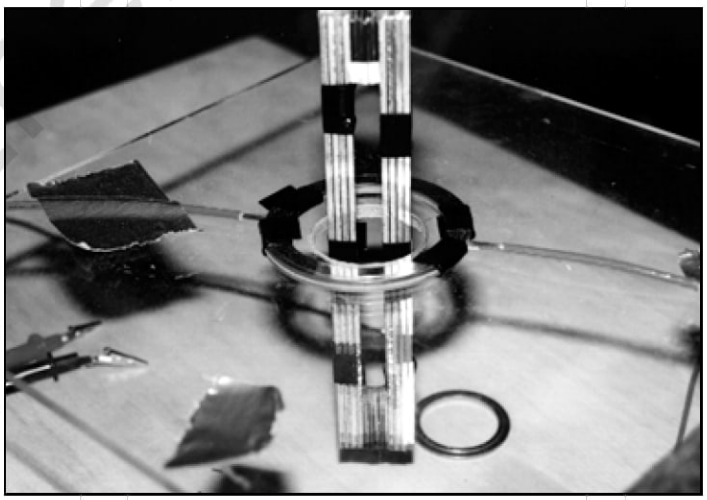
No doubt the work to be described below is also ignorable! but the extreme simplicity of the Marinov motor makes it an easy enough machine for anyone to build and test for himself. Also the motor's simple design may make it ideal for micro and nanoscale applications--no other genuine electric motor is likely to be easier to fabricate. If so, then it will be: "Damn the theory! Full speed ahead!"

Stefan Marinov never called his motor a "Marinov motor", but rather referred to it as his "Siberian Coliu". Dr. James Wesley, in a paper entitled "The Marinov Motor; Induction with no B field" (3), coined the name and it likely will stick. It was the forwarding by Thomas E. Phipps, Jr., Ph.D. (4) to me of Wesley's paper, and the subsequent forwarding of this paper by me to Tom Ligon, Engineering Technologist (5), that led to me getting involved with these other two in explorations of the Marinov motor.



The Essential Marinov Motor

(Illustration courtesy Tom Ligon, Assorted Technical Expertise)



Unthinkable!—
Marinov Motor Turning the Magnet Torus
Photo: Courtesy Jeffery Kooistra

Marinov had a number of different designs, which Phipps ignored along with Marinov's claims of perpetual motion, violation of conservation of energy, suicide threats, etc. Then Wesley produced his paper within which was a simple diagram similar to the figure, which made clear the essence of what Marinov had been proposing. It will be seen that the central element is a flux-containing permanent magnetic toroid (such as can be formed by putting together two U-magnets or horseshoe magnets) in the shape of a long rectangle, surrounded by a simple conducting ring. Direct current is introduced at one point of the ring, closely adjacent to one side of the toroid, and (after dividing, half going in each direction) is led out at a point diametrically opposite.

What is most interesting about the Marinov motor is that you get ring rotation (or toroid (armature) twisting in the event of a fixed ring, toroid free to turn arrangement, as shown) even though there are no **B** fields (other than stray ones) to act on the current in the ring, and no **E** fields either. Furthermore, all well-behaved **B** fields are supposed to act on a current carrying wire in a cross-product fashion--that is, all forces are supposed to be perpendicular to both **B** field vector and **i** current direction. Yet the Marinov motor displays ponderomotive forces (forces on the metal of the ring itself, not just the conduction electrons within the metal) parallel (and anti-parallel) to the direction of the current. Wesley's paper explains where the force to drive the ring comes from by assigning real physical meaning to the magnetic vector potential, **A**.

A deep dive into the theory of the Marinov Motor is not the purpose of the present brief paper. That's the province of both Wesley and Phipps, who have had some disagreements about it. Phipps, Ligon, and I have all gotten ring rotation or armature turning in the opposite direction to what Wesley says it should be, and Phipps thought he had a torque derivation that was better than Wesley's. Last I heard Phipps thought he'd figured out Wesley's sign mistake, but at the cost of accepting that Wesley was essentially right about the torque. This

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should lead the reader to realize that in real research, you routinely go down wrong alleys and oftentimes wind up changing your mind. Still, suffice it to say that Wesley's theory is at odds with conventional wisdom, and as discussed above, the Lorentz force law doesn't cover as many bases as physicists are taught that it does in school.

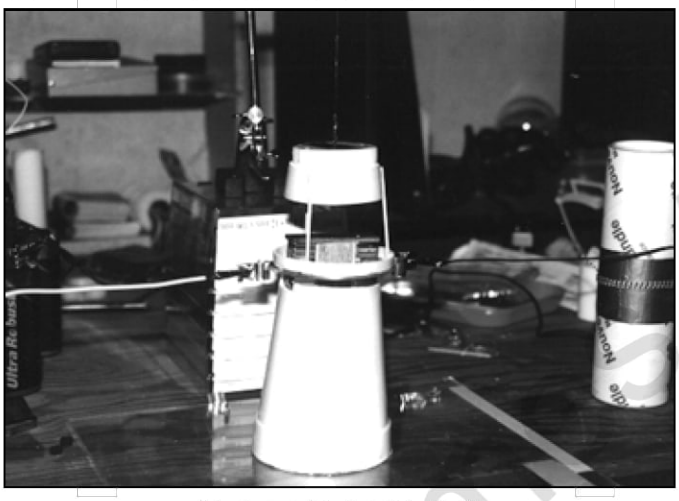
To continue with my history, the first experimental work in the U.S. on the Marinov motor was that of Tom Ligon, who recognized immediately and ingeniously that the simple way to see if there was anything to this Marinov motor business was to suspend the toroid with a string and run current through a fixed ring. Having on hand some potent magnets, a supply of copper rings used in vacuum work, and a power supply capable of putting out a few amps of current, he showed within only minutes that the toroidal armature would turn briskly when current was applied to the ring.

It cannot be emphasized enough just how easy it is to demonstrate that the Marinov motor does, in fact, work. Ligon was working from absolutely nothing more than the simple Wesley illustration. His toroid was fashioned from two pieces of flat steel with two short stacks of potent little rare earth magnets affixed in the positions of the short sides of the toroid in the figure. There was nothing quantitative about Ligon's observations other than that something was witnessed to happen rather than nothing. But that's all it takes sometimes.

Through that modern reporting miracle of E-mail, Ligon reported his results to me, and I then mentioned them to Phipps in one of our routine letter exchanges. At that point, none of us were really "working" on the motor. In short order, Phipps, being a genuine article experimental physicist, set about conducting torque measurements to see if Wesley's theory measured up empirically to his predictions. Phipps found that Wesley's torque predictions were correct to within 10-15t of what he measured (this data to be published by Phipps)(6). Given that Wesley's predictions were calculated on the basis of idealized elements, and Phipps went to almost no effort to idealize any of his real components, this is almost better than could have been expected.

I, having small children and thus lagging behind the others, finally adopted the Ligon approach and made my own rotating armature, and got similar rotational results to both Phipps and Ligon.

At this point it might be worthwhile to discuss that problem in signs we found with Wesley's paper. Simply, all three of us had toroids that rotated in the reverse way from what Wesley said they should. In Wesley's initial illustration that we all worked from, there is some ambiguity in the actual direction of the B field within the toroid, and although Wesley drew arrows and used a battery symbol that represented negative current, his calculations were actually done using traditional, or positive, current. This has led to much confusion about where the sign mistake is, but since all three of the experimenters got the same result, it's probably fair to say that the way rotation is depicted in the figure is the way that the Marinov motor rotates, provided that the toroid is not excessively "leaky".



Marinov Motor Mark II.
"THESE THINGS ARE SIMPLE TO BUILD!!!"
— Jeff Kooistra ***Photo: Courtesy Jeffery Kooistra***

In my own initial design, I used strips of steel (about eight inches long, half an inch wide, an eighth of an inch thick, four to a side), and connected them together with a stack of five rare earth magnets, nominally each at 1.7 kilogauss surface field, top and bottom (7). In a second design, I used two stacks of rare earth magnets (ten high on each side, about one and a quarter inches total height of the stack), nominal field of 3 kilogauss on the surface of each little magnet (8), spanned across the short top and bottom of the torus by steel strips again.

> ***Is this really a demonstration of new physics? Of forgotten old physics? More work needs to be done. But what I can tell you is that I, as a lifelong physics fan fearing that physics had gone stale, haven't had this much fun in a long, long time.***

Referring again to the figure, with the field in the toroid arranged so that it is flowing in a clockwise direction, when the positive lead is connected on the right side, the armature will start to turn counterclockwise, and there will ambiguous about it--it's quite brisk even when t lantern battery as a power supply. After it's degrees, it hits an area of the ring where the reversed and its tendency will be to rotate in direction. Clearly from a geometrical standpoint alone, an armature will not rotate if continuous current is applied—it will twist to one side and eventually settle down displaced from the position at which the current is brought in. However, if one pulses the current at the right frequency, it is easy to pump the torus up to a rapid rate of rotation.

The learning curve on the Marinov motor is a steep one. Once Phipps, Ligon, and I all had working models, new ideas occurred to each of us. Ligon pointed out that, given the low resistances involved, one should be able to add a second ring connected in series to the first. All you needed to do was run a wire from the output of the first ring around to the input of a second ring, and then draw current off the second ring to close the circuit. He thought that this should double the torque quite readily. The first experimental confirmation that the "Ligon stack" works came from my lab, since my experimental setup was the easiest to modify.

Of course, the self-styled cognoscenti of physics are likely to look at the illustration of the Marinov motor, note that there is a radial component of the ring shown, and declare that the force on the ring IS-IS-IS dammit! just the Lorentz force law of **F** = **i**L x **B**, since a ring with a sizeable horizontal cross-section could send enough current in a radial direction for some hypothesized leakage fields"' to act upon. (The difference between the outer and inner radii in a typical ring we'd been using was about 3/8ths of an inch, for a total L term of almost 3/4th of an inch.) Having thus explained away the Marinov motor, they can then go on their merry way. Yet we also noticed this, and I showed that the force on the turning armature remains the same whether or not you use a ring or substitute a thin conducting shell of about the same average radius. With a shell you hugely reduce any **i**L radial term, so if there were anything to this leakage field **i**L x **B** business then a shell should be much less

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effective than a ring.

At this point, the careful reader will have noticed that all of the work with the Marinov motor discussed so far has been conducted on a fixed ring, turning toroid model. The toroid, as discussed above, will not rotate completely when current is applied. The interesting question then is this: Will the ring really rotate continuously when the toroid is fixed and the ring is free to turn? It should since the toroid and the current input positions never change with respect to each other.

***The First Rotating* Marinov Ring in the US —at Jeff Kooistra's Home**

Photo: Courtesy Jeffery Kooistra

But does it really?

The reason Ligon hung his toroid in the first place was because constructing a genuine Marinov ring rotator is a lot harder than making a torus turner. How do you support the ring? Do you float it? On liquid? On air? And what about brushes? You need to keep the resistance low, and unless you have a machine shop, how do you go about making low resistance, low friction brushes (unless the possibility of Mercury poisoning doesn't both you)?

While Phipps was busy working out Wesley's theory and attempting to achieve confirmations, and Ligon was busy with his toroids and conceptualizing improvements for a practical device, I adopted as my task the construction of a genuine, Marinov ring rotating machine. Nothing fancy, just something that would, in fact, rotate the way Marinov said it did. Thrifty Hollander that I am, I also wanted to use only supplies readily at hand. I was not interested in building anything one could actually use, no more than the inventors of the first transistor expected to be able to use their first model in a radio the next day.

I'm a fan of Tesla. That great inventor once said that many people rush to the lab too quickly, and start tinkering in the dark and wasting time. The quickest approach to a sound experiment is to do nothing but think hard about what one wants to do, and eliminate in the mind the unworkable right up front. After considering means of levitating the ring, which included floating the ring on styrofoam in a basin of water, or potentially building an air bearing, I suddenly realized that it would be far easier to just hang the ring from a thread in a suitable, low-torque way, around the toroid. This would never make a practical device, but so what? The whole point was to get at least one full rotation, in the Marinov manner, of the ring.

There will be an upcoming "Experimenter's corner" detailing how one can build a little Marinov motor demonstrator. Most of you reading this column I'm sure already know enough now to build your own without any further input from me. No doubt home experimenters will think up lots of even better ways to build them, as Phipps, Ligon, and I do ourselves with each passing day. But at this point it is only necessary to say that I succeeded in my early experiments. It is a fact that when current is introduced to a Marinov ring with brushes and the torus is fixed, the ring does rotate. At the time of writing, I've managed to get the ring to rotate easily, despite using sticky, aluminum foil brushes that tend to spot-weld to the copper ring.

It is a strange feeling to watch the ring rotate. You have to understand enough physics to appreciate it, though. But when Ligon and I first saw the Wesley illustration, we spent a lot of time twisting our hands around in right-hand-rule attempts to find a net force to rotate the ring.

I don't think there is one in regular physics, though it's certainly there in reality.

I don't want to be doctrinaire about it. If an explanation in conventional physics does exist to explain the rotation, I'd love to see it. But I don't want a theoretical explanation unsupported by experimental verification. Personally, I am not enamored of Wesley's theory, nor do I think Marinov understood what he was doing. What I do have is a toroidal magnet and a copper ring supported with fishline which rotates when I run current through it.

Is this really a demonstration of new physics? Of forgotten old physics? More work needs to be done. But what I can tell you is that I, as a lifelong physics fan fearing that physics had gone stale, haven't had this much fun in a long, long time.

Jeffery D. Kooistra

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Demystifying the Marinov Motor

by Thomas E. Phipps, Jr.
908 South Busey Avenue, Urbana, Illinois 61801

Introduction

Electromagnetism (EM) is supposed to be among the most elegantly perfected aspects of physical theory. Like canonical mechanics and thermodynamics, it forms a set of highly polished dogmata, inherited from the nineteenth century, that are injected into the modern student in what is considered to be essentially finished form … meaning, finished for all time. Yet occasionally in any branch of physics a stumbling block appears that seems to offer practitioners only two options: To ignore it and hope that it will go away, or to face an agonizing reappraisal of theory. (Such a stumbling block, by the name of "cold fusion," arose recently in the related field of nuclear physics. One of the many instructive consequences was the initiation of this magazine.) In EM a newly-arisen stumbling block has been designated the "Marinov motor" by Wesley. (Marinov himself called it "Siberian Coliu.") Naturally, physicists have never heard of this motor … one feels sorry for them, they have evolved a refereeing system so perfect in insulating them from surprises that they must lead relatively boring professional lives (for is not "information" measured in terms of surprise?). In a word, this motor *works*, as has been recently verified empirically by independent investigations of Ligon, Kooistra, and myself in this country and possibly of others besides Marinov elsewhere.

The trouble with the Marinov motor is that – like the well-known bumblebee of aerodynamics – theory forbids it to work, yet it works. Like any motor, it is manifestly and necessarily driven by what is termed *ponderomotive force*. The resources of accepted theory to describe EM force are encapsulated in the famous Lorentz force law,

$$\mathbf{F} = q[\mathbf{E} + \mathbf{v} \times (\nabla \times \mathbf{A})] \qquad (1)$$

where

$$\mathbf{E} = -\nabla\phi - \frac{\partial \mathbf{A}}{\partial t} \qquad (2)$$

Here ϕ, are the scalar and vector potentials, the latter related to magnetic field by $\mathbf{B} = \nabla \times \mathbf{A}$. (I omit conventional factors of c, the speed of light. The reader can reinsert them by substituting ct wherever t appears and **v**/c wherever **v** appears.)

In the Marinov motor, as described by Wesley[1] and illustrated in Fig. 1, a permanent magnet of roughly toroidal shape (resembling a toroidal solenoid or "choke" containing its own **B**-field flux) is encircled by a "ring" conductor. Direct current is introduced into the ring at one side and led out at the other. There are two versions: (1) If the toroid is suspended so that it is free to turn azimuthally, it will do so, provided the vertical plane of the toroid initially coincides with that of the current lead in-out points on the horizontal ring. (2) If the toroid is fixed in the lab, and current is brought in and out of the ring by conductive brushes, so that the ring (supported in bearings) is free to rotate, it will do so up to ninety degrees. The sense of rotation is observed to obey the following rule: If conventional (+) current is introduced at a point adjacent to that part of the magnetic toroid in which the internal flux vector points *up*, the toroid will turn CCW in case (1), above, and the ring will turn CW in case (2), as seen from above. If conventional (-) current is similarly introduced, these senses of rotation are reversed.

Let us interrogate our force law (1) for an explanation. First, we note that things are electrically neutral, so the electrostatic potential $\phi = 0$. Secondly, $\partial A/\partial t = 0$ because the magnetic properties of our toroid and of our current-carrying ring do not vary as an explicit function of time. Hence $\mathbf{E} = 0$. Thirdly, in an ideal toroid, whether a permanent magnet or solenoid, **B**-flux is wholly contained; so $\mathbf{B} = \nabla \times \mathbf{A}$ should vanish at the external position of the ring. This would imply vanishing of the Lorentz or Grassmann force term, $\mathbf{v} \times \mathbf{B}$ in Eq. (1), and thus the vanishing of all force **F**. There remains the possibility that "leakage flux" is driving the motor. Kooistra (2) has done experiments that seem convincingly to exclude this option. However, it will suffice here to point out that the current velocity **v** within the ring is everywhere directed *azimuthally*, so that regardless of the direction in space of any leakage **B**-flux vector the cross product of **B** with **v** must be a vector lying in a plane transverse to **v** and thus directed radially or vertically. There is in such a situation a well-known transverse effect known as a Hall voltage. But this is electromotive, not ponderomotive, and is in any case not azimuthally directed. Moreover, the magnetic part of the Lorentz force because of its transverse directedness can do no work. The work needed to drive a motor requires force action parallel to the motion produced. The Lorentz law, Eq. (1), cannot describe the work performance that is observed.

We have thus a major empirical challenge to theory, as now constituted. But things are not hopelessly obscure on the side of theory. There are some clues as to how to *change* EM theory to bring it into line with observation. As suggested in our opening paragraph, the main obstacle is apt to be a lack of will to change things, a preference to ignore and hope. This is human nature, about which nothing can or should be done. (Are physicists human? In general, yes … it is only the authorities among them whose behavior encourages substantial doubt.) Nobody who has yet tried to reproduce the Marinov motor observations has failed to do so. Hence physicists in this instance lack the excuse for aloofness (so brilliantly exploited in the cold fusion case) that the reported anomalies are not reproducible. Let us identify the available clues, mostly expressible as questions, and get to work following them up.

Some Questions

Wesley has shown[1] that the Marinov motor is driven by a force expressible as test charge q times a total time derivative of the vector potential,

$$d\mathbf{A}/dt = \partial \mathbf{A}/\partial t + (\mathbf{v} \cdot \nabla)\mathbf{A} \qquad (3)$$

where **v** may be considered a velocity of "convection" — e.g., of the force detector, test charge, or in this case a mobile charge (electron) drifting with current in the ring. (Unlike **B** in the idealized case, **A** is nonzero outside the magnets.) The simple motor torque formula derived[1] by Wesley can be considered empirically verified[3]. So, we understand the general nature of the force at work and can describe it quantitatively by means of $d\mathbf{A}/dt$. It remains to establish how $d\mathbf{A}/dt$ fits into the general force law picture.

(1)There are chinks in the armor of Maxwellian physics … persistent questions. For instance, why does there have to be a separate force law, not contained in field theory itself, when the definition of the

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E-field is "force" on a unit test charge? Is it not a short-coming of EM field theory that it acknowledges EM "force" as a physical fact but does not fully and integrally describe it?

(2) More questions: Why is there an explicit appearance in Maxwell's equations of source velocities but not of sink velocities? Why so much talk of source-sink "reciprocity" when the formalism does not parametrically support such a thing?

(3) "Covariance" is claimed by its devotees to be just as good as "invariance." Should we believe the claim? It glitters, certainly … is it gold? And why skip over the whole question of first-order (Galilean) invariance to apply second-order solutions (involving v^2/c^2) to first-order problems? All our force problems involving gross, observable consequences, such as rotation of the Marinov motor, are first-order phenomena. Is it not embarrassing to physicists that they can tell no *invariance* story, limited – as so many of their actual observations are – strictly to first order? In other words, why is there no *invariant physics of the first order*?

(4) What is the operational meaning of the field symbols appearing in Maxwell's theory? The fields do not exist without detectors, just as in quantum theory … in fact EM theory is a classical gloss of quantum doings. So, does the state of motion of the *sine qua non*, the field detector, have no effect on the numbers displayed by it? And, if it does have an effect, why do the field equations contain no *parameters* to describe such a state of "relative" motion? (This is a rewording of question (2) above.) How can one dream of basing a *motional relativity theory* on an EM theory that does not even parameterize the motions of all relevant physical objects?

(5) What on earth is the status of the "potentials" in EM theory? Because of their gauge invariance, they are generally considered to be not "real" (although there are those of us who might like to apply this compliment to the fields as well). But this is a curious variety of reasoning, for other kinds of invariance are supposed to confer reality; in fact invariance is touted by relativists as the identifying hallmark of the *real*. (Naturally, they overlook the fact that their theory at no order of approximation offers *true invariance* – only covariance.)

(6) What about the Aharonov-Bohm experiment? With its electron ring surrounding a solenoid it looks suspiciously like a Marinov motor in the small. So, are the potentials less real than the fields? The answer seems to be yes, until the fields fail catastrophically, at which point the potentials are let in the back door and allowed to work for food … like indigent berry pickers paid by the basketful.

(7) Where do we stand on the Dirac electron equation? As in most quantum theory, Dirac used an energy-momentum (Hamiltonian) formulation and applied what he called a "classical rule" to bring EM into his description of the electron. But we shall see in a moment there was something peculiar about his application of this prescription – apart from the fact that it involved not fields but potentials and was wildly successful in describing what we take to be "real" things.

Formal Fiddlings (I): The Dirac Fiddle

I'm afraid, at this point, things are going to get rather hairy for those uninstructed in the math of EM theory. But there is nothing deep, just one key vector identity,

$$\nabla(\mathbf{a}\cdot\mathbf{b}) = (\mathbf{a}\cdot\nabla)\mathbf{b} + (\mathbf{b}\cdot\nabla)\mathbf{a} + \mathbf{a}\times(\nabla\times\mathbf{b}) + \mathbf{b}\times(\nabla\times\mathbf{a}) \quad (4)$$

which you can find in an appendix of Stratton[4] or many other places. Letting **a** = **v**, where **v** is a constant particle velocity (independent of space variables), and **b** = **A**, our vector potential, and recognizing that the differential operator with respect to space variables, ∇, acting on **v**, always yields zero, we derive from (4) the useful identity

$$\mathbf{v}\times(\nabla\times\mathbf{A}) = \nabla(\mathbf{v}\cdot\mathbf{A}) - (\mathbf{v}\cdot\nabla)\mathbf{A} \quad (5)$$

Beginning with the accepted classical "Lorentz" force law, Eq. (1), and using identity (5), we get

$$\mathbf{F} = q\left[-\nabla\phi - \frac{\partial\mathbf{A}}{\partial t} - (\mathbf{v}\cdot\nabla)\mathbf{A} + \nabla(\mathbf{v}\cdot\mathbf{A})\right] \quad (6)$$

With the help of Eq. (3) this can be written

$$\mathbf{F} = q\left[-\nabla(\phi - \mathbf{v}\cdot\mathbf{A}) - \frac{d\mathbf{A}}{dt}\right] \quad (7)$$

Finally, on introducing Newton's second law, $\mathbf{F}=d\mathbf{p}/dt$, where **p** is momentum m**v** of the charge q, we obtain after a minor rearrangement

$$\frac{d}{dt}(\mathbf{p} + q\mathbf{A}) = -\nabla q(\phi - \mathbf{v}\cdot\mathbf{A}) \quad (8)$$

Here we have on the left side the total time derivative of a sort of generalized "momentum," and on the right side the negative space gradient of a sort of generalized potential "energy"—force being a space derivative of energy (or, perhaps more recognizably, energy being the integral of force times a space increment). Eq. (8) is the *classical prescription*, based entirely on accepted mathematical reasonings. If we write energy as the transition from free particle to particle in an EM field is expressed by the formal rule.

$$\mathbf{p} \rightarrow \mathbf{p} + q\mathbf{A} \quad , \quad p_o \rightarrow p_o + q(\phi - \mathbf{v}\cdot\mathbf{A}) \quad (9)$$

This rule incorporates and embodies the Lorentz force law and Newton's second law.

Now we come to Dirac.[5] He expressed free particle energy-momentum in a classical relativistic form, linearized it, and then introduced the effects of an EM field in words so incisive that we feel obliged to quote them exactly: "…we follow the classical rule of replacing p_o and **p** by

$p_o + e/c\cdot A_o$, and $\mathbf{p} + e/c\cdot\mathbf{A}$, A_o and **A**, being the scalar and vector potentials of the field at the place where the electron is." Let's translate that into our notation: We have taken *c* as unity and Dirac's *e* becomes our *q*. His p_o is particle energy, which in quantum theory becomes a partial time derivative – never mind that. The important thing is that his A_o is our scalar potential ϕ. That's all, ϕ alone. And he calls this "the classical rule." But in fact we have just seen that the classical rule, Eq. (9), is *not* to replace "energy" p_o by $p_o + q\phi$ but to replace it by $p_o+q(\phi-\mathbf{v}\cdot\mathbf{A})$. The lat-ter is what is needed to replicate the classical Lorentz force law.

So, Dirac has quietly altered the "classical rule" and junked the Lorentz force law. In effect he has boldly got rid of the unwanted extra term in **v** by adding to the right side of Eq. (8) a new force term

$$\mathbf{F}_{Dirac} = -q\nabla(\mathbf{v}\cdot\mathbf{A}) \quad (10)$$

leaving

$$\frac{d}{dt}(\mathbf{p} + q\mathbf{A}) = -\nabla q\phi \quad (11)$$

You may not want to look at it that way … rationalize it as you will. But we all must accept that the results of this fiddle were *successful* beyond any measure of human predictability. Anyway, let's keep Dirac's extra additive force term, Eq. (10), stowed away in the back of our mind—because we are going to meet it again soon in a different context.

Formal Fiddlings (II): First-order EM Invariance (Hertz's Equations)

In a book I wrote some years ago[6] I pointed out that Einstein skipped over first-order physics in leaping at once to "universal covariance." This is a dangerous thing to do: One needs to get first-order physics right *first*. Earlier, Hertz[7] had done better. He noted that Maxwell's equations were *not invariant* under inertial (Galilean) transformations of coordinates, but that this flaw could easily be corrected. In effect what one had to do, besides modifying source terms in a trivial way to account for Galilean velocity addition, was to *replace all partial time derivatives in Maxwell's theory with total time derivatives*. Then, presto, one gets rigorous first-order invari-

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ance, with no opening for co-variance. Let's see how this works with one of the Maxwell equations, say,

$$\nabla \times \mathbf{E} + \frac{d}{dt}\mathbf{B} = 0 \qquad (12)$$

wherein the usual $\partial/\partial t$ operator has been formally replaced by its total time-derivative counterpart. Analogously to Eq. (3), we have

$$\frac{d}{dt} = \frac{\partial}{\partial t} + (\mathbf{v}_d \cdot \nabla) \qquad (13)$$

Eq. (12) can be written

$$\nabla \times \mathbf{E} + \frac{d}{dt}(\nabla \times \mathbf{A}) = \nabla \times \left(\mathbf{E} + \frac{d\mathbf{A}}{dt}\right) = 0$$

which implies that the last bracketed quantity is curl-free, so it can be expressed as the gradient of a scalar function,

$$\mathbf{E} + \frac{d\mathbf{A}}{dt} = -\nabla\phi \quad \text{or} \quad \mathbf{E} = -\nabla\phi - \frac{d\mathbf{A}}{dt} \qquad (14)$$

This last will be recognized as the invariant version of the **E**-field definition, Eq. (2). Here ϕ and **A** are indeterminate within what is called a "gauge transformation," to be discussed presently.

In connection with Eq. (13) it is necessary to wave a warning flag about the convective velocity parameter $\mathbf{v}_d$. This matter of physical interpretation fatally tripped-up Hertz. He thought that $\mathbf{v}_d$ could be identified with ether velocity, and further assumed a Stokesian ether convected by material bodies; hence $\mathbf{v}_d$ described the velocity of any "body" in the lab. This misapprehension – which led to the false prediction that a dielectric rotated in the lab should produce a magnetic field—was soon refuted experimentally[8] and his theory was discredited. But in my opinion Hertz's mathematics deserved to be saved, just as Maxwell's math was saved when his physical ether interpretation was discredited. In fact, because of its first-order invariance and the fact that it is a "covering theory" (inclusive) of Maxwell's EM, Hertz's math may be more deserving of salvation than Maxwell's. (But of course that would throw a monkey wrench into Einstein-Minkowski covariance.) Those who are irreversibly convinced that universal covariance is the royal road to Truth should be grateful to history for Hertz's early demise.

How, then, should $\mathbf{v}_d$ be physically interpreted? Earlier I raised a question about the ignoring of sink motions in Maxwell's theory. Here is a chance to correct that oversight by interpreting $\mathbf{v}_d$ as *field detector* (e.g., test charge, absorber, or radiation sink) *velocity with respect to the observer's frame of reference*. The test particle or detector, which "creates" the local field by its act of detection, then becomes integrally incorporated in field theory through the basic parameterization of the field equations. As far as I know, this leads into no traps of violation of observed results, and hence makes the world safe for Hertz's first-order invariant covering theory of Maxwell's equations. (Higher-order approximations need not concern us here, since we modestly aim only to account for the Marinov motor, a manifestly first-order device.) Let us then proceed accordingly.

What we have learned from imposition of the first-order invariance requirement, applicable to all equations of EM theory, is that partial time derivatives are to be formally replaced by total time derivatives. In fact, without knowing it, we have already begun to do just that. For, consider the "Dirac streamlining" by which the Lorentz force equation (8) was replaced by (11). By transposition, the latter can be written as

$$\frac{d\mathbf{p}}{dt} = q\left(-\nabla\phi - \frac{d\mathbf{A}}{dt}\right) \qquad (15)$$

EM theorists will recognize the right-hand side of (15) as proportional to the invariant counterpart of the usual definition of the electric field in terms of potentials, Eq. (2). And this in fact is what we have already independently deduced [Eq. (14)] directly from the invariant Hertz equation, Eq. (12).

Now an interesting and very significant thing has happened as a result of our just following our noses in these formal proceedings. The right-hand side of (15) represents obviously a physical force, and deserves to be written as **F**, since the left-hand side represents observable particle momentum rate of change. And the same right-hand side of (15), as we noted, is proportional to the invariant form of the definition of **E**. Hence we have the revolutionary equality

$$\mathbf{F} = q\mathbf{E} \qquad (16)$$

another consummation devoutly to be desired—since it answers another of our questions, the one calling attention to the peculiar circumstance of the dog in the night – that Max-well's equations, although they deal with forces on charges, do not incorporate a force law. Now, by virtue of Eq. (16), our modified Hertzian invariant covering theory of Maxwell's equations does *incorporate a force law*; so that mini-mystery is cleared up.

I hope the reader is skeptical enough to be questioning my claims of first-order "invariance" … because what this whole exercise is about is skepticism – unwillingness to take the word of authority for anything. For real skeptics, then, and for literature fanatics, I mention that the necessary proofs of invariance have been published in several places,[9] and for completeness a proof is included in an Appendix to this paper.

But what, I can hear the reader asking, about the Lorentz force law? Let's have another go at that. Suppose we write Eqs. (1) and (2) as

$$\mathbf{F} = q\left[-\nabla\phi - \frac{\partial\mathbf{A}}{\partial t} + \mathbf{v}\times\nabla\times\mathbf{A}\right] + X \qquad (17)$$

where X is an undetermined quantity to be discussed. Applying identity (5) and Eq. (3), we reduce this to

$$\mathbf{F} = q\left[-\nabla\phi - \frac{\partial\mathbf{A}}{\partial t} + \mathbf{v}\times\nabla\times\mathbf{A}\right] + X \qquad (18)$$

Now, following Dirac, suppose we use his "streamlining" procedure of adding to the force law the extra force term given by Eq. (10). Thus we take our unknown additive quantity to be $X = -q\nabla(\mathbf{v}\cdot\mathbf{A})$. Then (18) reduces to

$$\mathbf{F} = q\left[-\nabla\phi - \frac{d\mathbf{A}}{dt}\right] = q\mathbf{E} \qquad (20)$$

which is just our old friend, Eq. (14) or (16), recovered by still another line of argument. In short, to make the Lorentz force law, Eq. (1), compatible with the requirement of first-order invariance under inertial coordinate transformations, we have to add a first-order correction term X, which converts Eq. (17) to

$$\mathbf{F} = q\left[-\nabla\phi - \frac{\partial\mathbf{A}}{\partial t} + \mathbf{v}\times\nabla\times\mathbf{A} - \nabla(\mathbf{v}\cdot\mathbf{A})\right] \qquad (21)$$

the last term being the overlooked joker in the pack. How could such a term have been forgotten? Well, first, through a profound and universal disregard for the importance of motional "relativity" (meaning formal invariance) *at first order*. That's how first-order mistakes get made and how they get overlooked until something gross like the Marinov motor smacks us in the eye.

Gauge Invariance

I have given the reader a heavy dose of formalism and really should relent. But if he has stuck this far we might as well go the whole way and show gauge invariance of the first-order invariant formalism … because modern physical theorists simply dote on "gauge" and I doubt that one of them in the whole country would listen to one word I say unless I have at least one word to say about "gauge." But let's try to keep it short in proportion to the practical significance of the subject.

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Another useful identity, obtained from Eq. (4) by letting **a** = **v** and **b** = $\nabla\phi$, is

$$\nabla(\mathbf{v}\cdot\nabla)\varphi = (\mathbf{v}\cdot\nabla)\nabla\varphi \qquad (22)$$

Consider an invariant form of gauge transformation defined by

$$\mathbf{A} = \mathbf{A}_o - \nabla\varphi \ , \qquad \phi = \phi_o + \frac{d\varphi}{dt} \qquad (23)$$

where φ is any scalar function independent of the potentials. Then in the force law written in the form of Eq. (21) substitute for A and ϕ from Eq. (23), use the identity (22) and the fact that curl(grad) is zero, and you will find that (21) preserves its form; *viz.*,

$$\mathbf{F} = q\left[-\nabla\phi_o - \frac{\partial\mathbf{A}_o}{\partial t} + \mathbf{v}\times\nabla\times\mathbf{A}_o - \nabla(\mathbf{v}\cdot\mathbf{A}_o)\right] \qquad (24)$$

wherein the "gauge" fiddle-function φ has canceled out entirely. Note that Eqs. (17), (18) are not gauge invariant *unless* X is given the particular value -q∇(**v**·**A**) needed to make the force law invariant. Thus, the requirement of invariance under the IGT, Eq. (23) furnishes yet another way of "deriving" the invariant force law, Eq.(20). It may be added that it is traditional to impose a supplementary condition on the potentials, to take up the fiddling slack. In our case the invariant form of this extra condition is

$$\nabla\cdot\mathbf{A} = -\frac{d\phi}{dt} \qquad (25)$$

which keeps its form under the IGT if $\nabla^2\varphi - d^2\varphi/dt^2 = 0$, an invariant wave equation.

Finally we inquire why the extra (last) term in (21), which is also the term Dirac eliminated by his fiddle (10), does not conflict with all the observations supporting the Lorentz force law. A clue lies in the reducibility of Eq. (8) to (11) by IGT, which shows the extra term in (21) to be of the nature of a gauge function. Subjecting Eq. (8) to our IGT (23), we find

$$\frac{d\phi}{dt} = q\left[-\nabla\phi - \frac{\partial\mathbf{A}}{\partial t} + \nabla(\mathbf{v}\cdot\mathbf{A})\right] = q\left[-\nabla\phi_o - \nabla\frac{d\varphi}{dt} - \frac{\partial\mathbf{A}_o}{\partial t} + \nabla\frac{d\varphi}{dt} + \nabla(\mathbf{v}\cdot\mathbf{A}_o - \mathbf{v}\cdot\nabla\varphi)\right] \qquad (26)$$

which can be put into the form of Eq. (11) if we take φ to be such that $\nabla\varphi = \mathbf{A}_o$ + *const*. For in this case the last gradient term in (26) becomes gradient of a constant, or zero, so

$$\frac{d\phi}{dt} = q\left[-\nabla\phi_o - \frac{\partial\mathbf{A}_o}{\partial t}\right] \qquad (27)$$

which is of the form of Eq. (11). The function φ in question transforms **A** to a constant, conforms to (25), and satisfies the condition $\nabla^2\varphi - d^2\varphi/dt^2 = 0$.

That Eq. (8) is reducible to the invariant form (11) or (27) by IGT means that its form is *changed* by the IGT, hence that (8) is IGT *non-invariant*. Indeed, the reduction (or Dirac "streamlining") is irreversible, since all possible IGT's applied to (11) or (27) leave that form unaltered. IGT non-invariance of (8) can be taken as evidence of non-physicality of the Lorentz force law. I choose to view the IGT invariance and Galilean invariance of φ,**A** in (11) as evidences of their "reality." Wesley cuts the Gordian knot of their apparent non-uniqueness, e.g., by *defining* **A** as a space integral of current density divided by separation distance. This amounts to assigning physical significance to the gauge. If we have Marinov motors to act as **A**-detectors, it seems to me that **A** "fields" must be physically as real as **B**-fields … and how real are **B**-fields, anyway? Aharonov-Bohm may now be seen as a classical effect – as Wesley(10) has maintained.

The Marinov Motor

I hope the reader is not still mystified by the Marinov motor, but just to make sure, let me tie up the loose ends. The EM force law is best written in a manifestly in-variant form such as Eq. (20). There we see appearing quite prominently a force term $d\mathbf{A}/dt$, which is just what Wesley started with in his excellent analysis(1) of the motor. So we have arrived at Wesley's starting point and can let him take over from here. The working part of this force, since $\partial\mathbf{A}/\partial t = 0$, is -$\nabla$(**v**·**A**). To explain how the $\mathbf{v}_d$ in our force law [Eq. (13)] becomes the **v** of the motor current, we have only to recognize that the **A** "field" felt by the drifting electrons in the motor ring is just that which would be measured by a co-moving detector; so detector velocity $\mathbf{v}_d$ and ring-current velocity are identical. As suggested above, this does require from us a new recognition—that **A** "field" detectors physically exist and can move with respect to the lab. That claim, since it has some physics in it, deserves to become a matter of controversy. But the motor itself is furnishing abundant evidence. Anyone who doubts it should go into his own basement or garage and try it out—it's that easy.

Acknowledgments

Analysis by J. P. Wesley first brought the Marinov motor to my attention; and analysis by Professor D. E. McLennan catalyzed the present alleged demystification. The continuing help and support of experimental investigators T. Ligon and J. D. Kooistra is acknowledged. They have skillfully forced Mother Nature to reveal one of her deepest-buried EM secrets—or one of her best jokes on physicists, depending on how you view it. I should add that the interpretation of the convective velocity parameter $\mathbf{v}_d$ given here presumes that the source of the **A**-potential is stationary in the lab. A better and more general interpretation, harking back to Weber's electrodynamics, is given by Wesley(1), who recognizes that this parameter is best interpreted as relative velocity of **A**-source and detector or sink. Something of the sort seems beyond dispute and is likely to prove the future key to a true relativity theory. But there are problems: When the **A**-source is a permanent magnet, what is its state of motion? That of the bulk material, or that of hypothetical Amperian currents? Electron spins are probably not best classically modeled as charge in motion. Here we strike some physics, a very rare occurrence in physics.

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Fig. 1. Sketch of Marinov motor

(SEE PRECEDING ARTICLE BY JEFFERY KOOISTRA, PAGE 38 —DIAGRAM BY TOM LIGON)

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Appendix. Invariance Proof

We consider the case of vacuum EM, and arbitrarily choose E and B as the field vectors. The Hertzian field equations are then

$$\nabla \times \mathbf{B} - \frac{d\mathbf{E}}{dt} - 4\pi \mathbf{j}_m = 0 \qquad \text{(A1)}$$

$$\nabla \times \mathbf{E} + \frac{d\mathbf{B}}{dt} = 0 \qquad \text{(A2)}$$

$$\nabla \cdot \mathbf{B} = 0 \qquad \text{(A3)}$$

$$\nabla \cdot \mathbf{E} - 4\pi\rho = 0 \qquad \text{(A4)}$$

The definition of the total time derivatives is given by Eq. (13) of the text. These equations reduce to Maxwell's in the special case $\mathbf{v}_d = 0$, and thus form an invariant covering theory. We wish to show their first-order invariance under the (Galilean) inertial trans-formation,

$$\mathbf{r}' = \mathbf{r} - \mathbf{v}t, \qquad t' = t \qquad \text{(A5)}$$

Here the **v** parameter is unrelated to the same symbol used in the foregoing text. It repre-sents the velocity of the primed inertial system with respect to the unprimed one. Writing (A5) out in component form, we see by the chain rule of differentiation that

$$\frac{\partial}{\partial x} = \frac{\partial}{\partial x'}\frac{\partial x'}{\partial x} + \frac{\partial}{\partial y'}\frac{\partial y'}{\partial x} + \frac{\partial}{\partial z'}\frac{\partial z'}{\partial x} = \frac{\partial}{\partial x'}$$

similarly

$$\frac{\partial}{\partial y} = \frac{\partial}{\partial y'}$$

and

$$\frac{\partial}{\partial z} = \frac{\partial}{\partial z'}$$

which in vector notation means that

$$\nabla = \nabla' \qquad \text{(A6)}$$

similarly, (A5) implies that

$$\frac{\partial}{\partial t'} = \frac{\partial}{\partial t}\frac{\partial t}{\partial t'} + \frac{\partial}{\partial x}\frac{\partial x}{\partial t}\frac{\partial t}{\partial t'} + etc. = \frac{\partial}{\partial t} + \mathbf{v}\cdot\nabla \qquad \text{(A7)}$$

This last follows from the fact that the x-component of the first equation in Eq. (A5) is $x' = x - v_x t$ or $x = x' + v_x t$, so $\partial x/\partial t = v_x$, etc. The meaning of the field vectors in Hertzian theory is that they are symbols standing for measured numbers read from the read-out of a "field detector," which is an instrument (a composition of matter) in a state of motion specified by the constant parameter , interpreted as detector velocity relative to the unprimed inertial system. We interpret

$$\mathbf{v}_d' = \mathbf{v}_d - \mathbf{v} \qquad \text{(A8)}$$

as velocity of *the same instrument* with respect to the primed inertial system. Observe that the Galilean velocity addition law is used, in conformity with our intention to keep the discussion consistently at the level of first-order approximation. Obviously, with this understanding about the meaning of the field vectors, they transform invariantly,

$$\mathbf{E}' = \mathbf{E}, \quad \mathbf{B}' = \mathbf{B} \qquad \text{(A9)}$$

That is, at any given moment both or all observers must read the same numbers off the read-out of the given instrument, regardless of their states of relative motion. By the same token a measuring device for counting charges per unit volume, whatever its state of motion, will yield the same numerical count of charge content to each observer, so

$$\rho'(\mathbf{r}', t') = \rho(\mathbf{r}, t) \quad \text{and}$$

$$\mathbf{j}'(\mathbf{r}', t') = \mathbf{j}(\mathbf{r}, t) - \rho(\mathbf{r}, t)\mathbf{v} \qquad \text{(A10)}$$

The latter involves the Maxwellian current density **j**, measured by an instrument at rest in the unprimed system, etc. We remark that Eqs. (A6), (A7), and (A10) are given in M. Jammer and J. Stachel, *Am. J. Phys.* 48, 5 (1980). But Eq. (A9), which is the key to the whole business, is not given there, for the reason that they interpret their symbols differently. Their analysis is quite wrong-headed, which means in general that it is first-line publishable. (The converse applies even more rigorously.)

Consider a different ("convective") current density defined by $\mathbf{j}_d = -\rho\mathbf{v}_d$. From (A8) we see that this transforms as

$$\mathbf{j}_d' = -\rho\mathbf{v}_d' = -\rho(\mathbf{v}_d - \mathbf{v}) = -\rho\mathbf{v}_d - \rho\mathbf{v} = -(\rho\mathbf{v}_d)' - \rho\mathbf{v} = \mathbf{j}_d' - \rho\mathbf{v}$$

or (A11)

$$\mathbf{j}_d' = \mathbf{j}_d + \rho\mathbf{v}$$

Let the "measured" current density appearing in the field equation (A1) be defined as

$$\mathbf{j}_m = \mathbf{j} + \mathbf{j}_d \qquad \text{(A12)}$$

We see from (A10), (A11) that, as a measured quantity should, $\mathbf{j}_m$ transforms invariantly:

$$\mathbf{j}_m' = (\mathbf{j} + \mathbf{j}_d)' = \mathbf{j}' + \mathbf{j}_d' = (\mathbf{j} - \rho\mathbf{v}) + (\mathbf{j}_d + \rho\mathbf{v}) = \mathbf{j} + \mathbf{j}_d = \mathbf{j}_m$$

. (A13)

The interpretation of these symbols is now clear: **j** is the current density measured by a detection instrument when at rest in the unprimed system; $\mathbf{j}_d$ is the increment of current density picked up when that same detector moves with velocity $\mathbf{v}_d$ relative to that system ($\mathbf{j}_d$ vanishes when $\mathbf{v}_d = 0$ and is defined with a minus sign to accommodate the fact that a detector moving in one direction is equivalent to a current flowing in the opposite direction); and, finally, by Eq. (A12), $\mathbf{j}_m$ is the sum of the statically-measured and motion-created currents, which is what is *measured* by a current-detection instrument co-moving at velocity with the field detector. The measured quantity is agreed on by all observers, as shown by its invariance, Eq. (A13).

The point of working with total time derivatives is that they are invariant at first order under inertial transformations. Thus

$$\left(\frac{d}{dt}\right)' = \left(\frac{\partial}{\partial t} + \mathbf{v}_d\cdot\nabla\right)' = \frac{\partial}{\partial t} + \mathbf{v}_d'\cdot\nabla' = \left(\frac{\partial}{\partial t} + \mathbf{v}\cdot\nabla\right) + (\mathbf{v}_d - \mathbf{v})\cdot\nabla = \frac{\partial}{\partial t} + \mathbf{v}_d\cdot\nabla = \frac{d}{dt}$$

(A14)

which follows from (A6), (A7), (A8), and Eq. (13) of the text. Although explicit appearance of c has been suppressed in this paper, we should remark that

$$c' = c \qquad \text{(A15)}$$

is an implicit assumption of both Maxwellian and Hertzian theory, and is essential to formal invariance of the field equations, to which we now turn. With all the preliminaries out of the way, we are finally ready for what is now a trivial demonstration. Eq. (A3) is obviously invariant,

$$(\nabla\cdot\mathbf{B})' = \nabla'\cdot\mathbf{B}' = \nabla\cdot\mathbf{B} = 0 \qquad \text{(A16)}$$

as follows from (A6) and (A9). Eq. (A4) is invariant from (A6), (A9), and (A10),

$$\nabla'\cdot\mathbf{E}' - 4\pi\rho' = \nabla\cdot\mathbf{E} - 4\pi\rho = 0 \qquad \text{(A17)}$$

Similarly, (A6), (A9), and (A14) establish the invariance of (A2),

$$\nabla'\times\mathbf{E}' + \left(\frac{d}{dt}\right)'\mathbf{B}' = \nabla\times\mathbf{E} + \frac{d}{dt}\mathbf{B} = 0 \qquad \text{(A18)}$$

Finally, the additional use of (A13) suffices to establish the invariance of (A1),

$$\nabla'\times\mathbf{B}' - \left(\frac{d}{dt}\right)'\mathbf{E}' - 4\pi\mathbf{j}_m' = \nabla\times\mathbf{B} - \frac{d}{dt}\mathbf{E} - 4\pi\mathbf{j}_m = 0 \qquad \text{(A19)}$$

It is seen that proof of invariance is quite trivial, but somewhat different from covariance proof, to which the relativist reader is more accustomed. When symbolic objects such as (*d/dt*) transform in place invariantly, we may refer to this as "manifest invariance." We see that the Hertzian field equations are manifestly invariant under

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Galilean transformations.

It would be interesting to see how these field equations behave under accelerative transformations. This is a problem for future analysis requiring some caution, as we are aware from known electrodynamics that new physical effects (radiation) arise under acceleration of the source—but not under acceleration of the observer or detector (?). These are first-order problems that should be attacked by *physicists* (if not too busy building twenty-first century physics on nineteenth-century first-order errors) without any use of special relativity theory, which is self-disqualified for the treatment of acceleration. As for general relativity theory, that is supposed to cope with accelerated motions, but it is also supposed to reduce to special relativity theory in the flat-space limit of the laboratory … so, ready, aim, shoot yourself in the foot.

OPEN LETTER TO *SCIENTIFIC AMERICAN*

DATE: 25 November 1997
TO: Philip Yam Staff Writer, Scientific American

FROM: H. E. Puthoff, Ph.D.
Director, Institute for Advanced Studies/Austin

SUBJECT: Open Letter
Re: December Piece on Zero-Point Energy

I have just seen your article in the December issue of *Scientific American*, and thought I would give you somefeedback.

First, I thought the companion piece, the *Scientific American Frontiers PBS* segment on zero-point energy (ZPE), was excellent, of exceptional quality, and placed before the viewers the issues involved in an objective fashion. The program captured the combination of the willingness of our Institute, the Institute for Advanced Studies at Austin, to investigate the possibility that the ubiquitous ZPE could be tapped, while at the same time showing our skepticism, backed by laboratory evaluation, of one of many claims that we have debunked.

As to your article, although you presented the technical issues with some accuracy, even brilliance, I hardly have to tell you that the "spin" was one of not-so-covert ridicule. Given the quality of *Scientific American* in general, and the earlier excellent and informative article on zero-point energy in particular (Tim Boyer's article "The Classical Vacuum," *Sci. Am.*, August 1985), this was quite unexpected. I must say in all honesty that I have dealt with a number of science journalists on the ZPE issue, both in the print and video media, from the *Economist*, to *Science* to the *New Scientist*, to *Horizon* and *Discovery* channels, as well as the present PBS presentation, and I found your piece to be the first to go out of its way to defensively position itself so as not to appear to be championing an area of study whose outcome was uncertain. As a scientist you should be among the first to realize that it is application of the scientific method, not the outcome, that counts, and there is no dishonor in investigating frontier or speculative concepts, provided the scientific method is adhered to rigorously.

Lest you think I'm simply thin-skinned about not gaining unabashed approval for what we're doing, let's examine just a couple of remarks, and I'll let you be the judge.

*** You highlight that Milonni of LANL runs into someone in a breakout session at the NASA Breakthrough Propulsion Physics meeting at NASA's Lewis Research Center who brings up astral projection. Although this might be titillating for an article in the *National Enquirer*, what does it have to do with physics in general, or the content of this article in particular? Obviously, only as a prop used by you, for some unfathomable reason of your own, to paint a tawdry picture of the NASA meeting, which in fact to any objective participant would be more appropriately characterized by the quality of presentation by a Krauss, a Tipler, a Cramer, a Chiao and, indeed, Milonni himself, all recognized to be leading scientists in their areas of expertise.**

(By the way, with regard to Milonni's expressed skepticism that you chose to highlight as a thread that runs throughout the article, it would appear that he failed to inform you that, with his encouragement, two of his colleagues at Los Alamos have designed and are now constructing a quite innovative and complex ZPE energy conversion device based on the Casimir effect..... At the NASA meeting I expressed to Milonni my own skepticism about the particular design in question, for which my input had been sought by the inventors, and questioned his encouragement.)

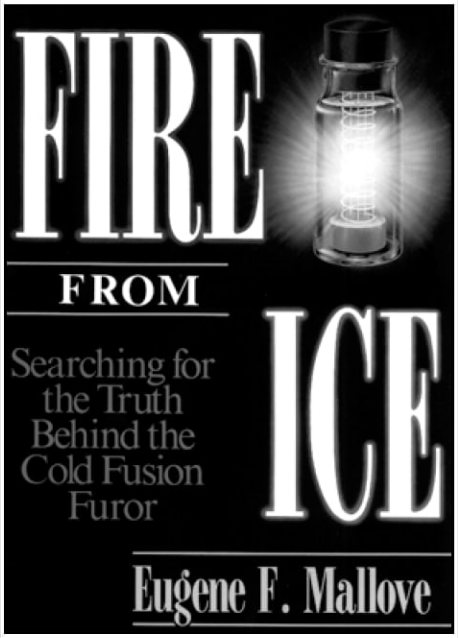
*** To set the tone of your article in the first paragraph, you introduce the Institute for Advanced Studies at Austin in terms of an unfavorable comparison as not to be confused with the similarly named Institute for Advanced Study at Princeton. As a writer you are well aware that this is a non sequitur if ever there was one. *Scientific American* is not to be confused with the similarly named American Scientist. So?**

Yes, the Princeton Institute is well renowned, and deservedly so, for the famous physicists who have passed through its doors. But I dare say that the Austin Institute, with its robust track record of over a dozen publications in mainstream physics journals over the last decade (primarily in *Physical Review*), its ability to attract visiting scholars, and its widely-recognized experimental expertise in energy measurement, has no difficulty in holding its own in a comparison with the Princeton Institute or any other reputable scientific organization. Again, we see in your piece a gratuitous "slam" with no justification.

*** Your article was quick to highlight, without a balancing viewpoint, that "some" regard investigation of the potential of ZPE as an energy source as "pseudoscience that could leech funds from legitimate research." In direct contrast to your chosen characterization, however, the Institute for Advanced Studies at Austin, which is highlighted in your piece, is well known in the research community as debunkers of the first water, and we have saved investor groups literally millions of dollars that might otherwise have been invested in self-deluded inventors or, worse, fraudulent schemes. I am told that my paper "Alternative Energy Sources: Good News/Bad News and the 'One-Watt Challenge'," presented at a 1994 Denver energy conference, remains a thorn in the side of misguided inventors and has alone saved millions of dollars of false investment. Therefore, rather than leech funds from legitimate research, we have an established track record of having saved such funds for wiser investment elsewhere, a major facet of our Institute's program that was highlighted in the PBS presentation but unaccountably absent in your article.**

*** Finally, given the tenor of the article throughout, it is not surprising that it would end with the cliche that "if it sounds too good to be true, it probably is." ZPE conversion too good to be true? Perhaps. Our nation has invested billions of dollars in the hot fusion program to investigate the possibility of developing an energy source "of nearly unlimited potential." Too good to be true? Again, perhaps. Would you have ended an article about hot fusion the same way? Perhaps. But then again, perhaps not.**

Philip, if I may end on a personal note, it may be the "in thing" in our community of peers to be cynical about the possibility of success in seeking new energy sources that are at the frontiers of our physics understanding and capability, and about which debate still exists. And of course skepticism about the promise of ZPE conversion, as about the promise of hot fusion, is fully justified. But I would invite you to expand your view beyond our PC's and air-conditioned offices to consider the plight of many, especially in third world developing countries, for whom any possibility of relief on the energy front means lives, not just comfort and convenience. This is especially true with regard to the impending water crises around the globe, with economically-viable desalinization the only solution in sight. In the light of these realities I would suggest that the unfortunate transition from healthy skepticism to self-protective cynicism about any possible energy solution is a self-serving luxury that we can ill afford, and that would be irresponsible for the scientific community to embrace. Fortunately, most of the scientific press is supportive of bold new attempts to address such issues, knowing that the self-corrective merits of good science can be counted on to separate the wheat from the chaff, and to optimize the outcomes for potential application. In my opinion, it is this reliance on the scientific method, not polemics, that should guide our efforts.



Fire from Ice:
Searching for the Truth Behind the Cold Fusion Furor

By Eugene F. Mallove, Sc.D.
Published by John Wiley & Sons, Inc., 1991, 334 pp.

A timeless treatment of the greatess-cientific drama of ourage..Nominated for a Pulitzer Prize in 1991.

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A Review of.....

Heretical Verities: Mathematical Themes in Physical Description

A review by Jeffery D. Kooistra

Heretical Verities: Mathematical Themes in Physical Description, by Thomas E. Phipps, Jr., Classic Non-fiction library, Urbana, Illinois. 1986, 637 Pages, ISBN 0-9606540-0-7

NOTE: This book is available for immediate shippment from Cold Fusion Technology, Inc. P.O. Box 2816, Concord, NH 03302 Prices, including first class air mail shippment: $45 North America; $60 other foreign.

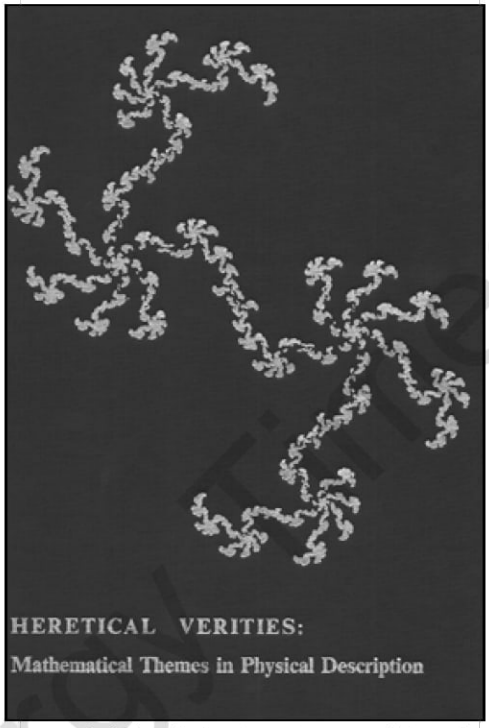
This reviewer might as well admit up front that he is a friend and co-researcher with the author of the book under review. This association came about as something of an accident, but when one meets a soulmate in terms of how you each look at and pursue science—well, I guess working together in some capacity becomes inevitable.

Heretical Verities: Mathematical Themes in Physical Description, is one of those gems of a book that has been actively ignored by the Scientific Establishment. Lots of books get ignored that perhaps should be, but this isn't one of them. Friends of New Energy research will be delighted by the attacks Phipps brings against Establishment physics, Establishment publications, and particularly, Establishment thinking. But a glance at the copyright date will reveal that Phipps was saying all this even before the Cold Fusion fiasco brought to light just how little science has to do with Big Science these days.

The book is divided into three parts: kinematics and electromagnetism; mechanics; and mathematics and statistics. In each section, Phipps is, in keeping with the title, as heretical as anyone could want. However, in keeping with his conservative views (at least as they relate to science—I have no idea what kind of political views Phipps holds) the book is only as heretical as it needs to be, and no more than that. What kind of conservatism is this? Well, the kind that we all think should be typical of science. That is, theories should be verified against experiment, and new theories should account for all the facts covered by the old one.

Before I encountered this book, I thought such was at least the case in physics, though I'd already grown cynical about just how well the average physicist obeys the mandates of his own profession. But I was wrong, and this becomes strikingly and frighteningly clear in the early chapters where Relativity comes under discussion.

Consider for a moment the classic "train in a station" example often used to explain



the relativity of simultaneity. One fellow is at the station and another is sitting atop the train at it's midpoint. Just as the train rolls through the station and observer A at the station is in line with observer B atop the train, two bolts of lightning strike, one at the front of the train, one just behind the caboose. Clearly, we are told, the observer at the station sees the two bolts strike simultaneously, and the observer aboard the train must see them strike at different times. What Phipps points out, and I'm sad to admit this never occurred to me before, is that we never bother to actually ask the guy atop the train whether or not he saw the bolts strike at different times. We assert that he does from the comfort of our stationary frame, but we don't ever actually ask him. Given the distinctly odd behavior we've come to understand with regard to light and, say, double-slit experiments, isn't it time we looked at this situation with something other than Einstein's purely classical understanding of the behavior of light?

Phipps describes a model in which photons "speed up" in response to an absorber, so that in the train situation, you'd actually have simultaneity be agreed upon by both observers. But since Phipps accepts that something like time dilation has been verified as true (though not length contraction), his theory chooses different invariants.

Now I can't do justice to much of Phipps' discussion, but at least now we're at a place where an argument can happen, whereas before we believed that all this was settled and the Theory of Everything was just around the corner.

Ah, the Theory of Everything—the Holy Grail of the "new physics". That to verify the truth of such a theory of everything would require the systematic empirical investigation of everything seldom comes up in the discussion. Early in the book (well, on page one of the introduction), Phipps gives his definition of new physics: "...any self-consistent physico- mathematical structure that a) accounts for existing experimental evidence and b) predictively differs in some observable way from existing physical theory." This definition would, of course, exclude most of what passes for new physics in the popular books. In Phipps' view, "The function and distinctive purpose of new physics, in short, is to give fresh employment to experimentalists."

Phipps certainly doesn't fall short in this regard himself, since he has actually conducted or at least devised many experiments, which he describes, that could distinguish between his theories and the accepted ones, and in so doing, shows where the soft spots are in prevailing theory. One thing seldom pointed out about special relativity is that it has no analog to rigid body dynamics. Consider something as simple as a rotating disk with a line scribed on it along a radius from center to edge. If this disk is set into high speed rotation, and allowed to spin for a good long time, what will happen to the inscribed line? Special Relativity does not have an accepted solution to this question. One theorist predicted that the line would curve backwards over time, and *Nature* pub-

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lished a nice diagram of the prediction. Other theorists also predict curvature, but to a different extent. Phipps, of course, actually put a disk into rotation and kept it going for a few months. There was no curvature. Phipps took a picture. But *Nature* didn't want to publish an actual picture of an experimental result. Phipps' paper came out in an obscure journal where it was soundly ignored.

Special Relativity does not have an accepted solution to this question. One theorist predicted that the line would curve backwards over time, and Nature published a nice diagram of the prediction. Other theorists also predict curvature, but to a different extent. Phipps, of course, actually put a disk into rotation and kept it going for a few months. There was no curvature. Phipps took a picture. But Nature didn't want to publish an actual picture of an experimental result.

Perhaps that's the saddest thing about *Heretical Verities*, where Phipps recounts again and again experimental work, all of it done in perfectly acceptable fashion, some by him, some by others, and all of it ignored, set aside, hushed up. Geez, what percentage of folks who call themselves physicists actually care about doing physics anymore?

One of the most interesting experiments mentioned in *Heretical Verities* is the Sherwin-Rawcliffe experiment, and it probably is a more important experiment than that of Michelson- Morley, or *would be* if anyone knew about it. I can't even explain it in the space I have here, but then, I want to tease the reader into buying the book, and there's the following quote from that section I want to mention: "It would appear that classical electrodynamics may be one of those areas of physics that have too-long served as unsupervised playgrounds for theorists, with the bare minimum of chaperoning by experimentalists. As in all such cases, there is a possibility that tacit assumptions contrary to fact have been built so deeply into the foundations that a successful critic would have to devote one lifetime to discovery and two more to 'sales'. I have not paid the price of admission to this particular recreational area, so cannot offer an informed opinion." In the time since *Heretical Verities* was written, Phipps has more than paid the price of admission.

The Sherwin-Rawcliffe experiment, which deals with the left- behind-potential-hill, (which turns out not to be left behind), has probably not been mentioned again since this book came out in 1986. Hence, it hasn't helped anyone notice that E&M theory has holes in it. Since the publication of the book, Phipps has linked up with Peter and Neal Graneau [who published *Newton Versus Einstein*—Ed. Note] and discovered a great deal more about those false "tacit assumptions" that have mucked up electromagnetic theory for the last century.

This is an important point to bring out, since it impinges so completely on the life of the New Energy researcher. We wonder if the disdain of the establishment we've been encountering, if the scorn heaped upon Pons and Fleischmann, if the refusal to publish our research, or even take it seriously, is something new. We wonder if there's some kind of grand conspiracy involved.

Well, perhaps in individual cases there is a conspiracy of sorts, but in general? Well, it would have to have been going on for a long time. Tesla encountered resistance from patent bureaucrats a century ago, and it's not clear that anything has changed since. Phipps recounts experiments and "ways of looking at things" that would have made it easier for the Establishment to unshackle itself from outdated theoretical dogma long ago, and yet, nothing happened. *Heretical Verities* lets us into the mind of a longtime heretic, of someone who has fought these battles for years and years against that Establishment, who has been honest about his defeats and continued anonymity despite all he's done. In short, *Heretical Verities* is the record of one man's war. And now that so many of us have had our own Pearl Harbors, the book should also serve as a call to arms.

"My message in this book, which now draws to its close, is that if you believe the experts when they tell you your native wit and critical sense are worthless then in your own case you prove them right...but if you resist their browbeating their is hope in your case for individual salvation -- though Barnum be right about the public."

Here I'm almost through with my review and I haven't even touched on sections II and III yet, but this is hardly necessary. Both sections are thought provoking and will teach you things that you should know, or open up doors and avenues that you never knew existed. In particular, the math section should be a joy to any working physicist who has had doubts about the way that mathematicians have stolen the interpretation of how the Universe works away from them.

But the one thing I must discuss is this: *Heretical Verities* is the funniest physics book I've ever read in my life. One cannot read the book for long without laughing out loud at how Phipps skewers the Establishment with hilarious jabs, puns, and double entendre's. For instance, in a section on the problems with Cauchy series, Phipps says: "In the long run, economy of effort is seldom attained through economy of thought. (Mathematicians prove to be surprisingly keen on economy of thought...downright miserly, some of them.)" ZING!!!

So what are we to make of *Heretical Verities*? In the preface, Dr. Pierre Noyes calls the book "...the life work of a very talented, dedicated and profound scholar and physicist; it should be respected on that ground alone." He also notes that the book is addressed to those "...'amateurs' and 'dilettantes' concerned with the foundations of physics and mathematics who have not been blinkered or blinded by a narrow, professional education—in fact, the modern counterpart of the audience Galileo addressed at the start of the scientific revolution." As a self-confessed member of that audience, I found this book a delight from one end to the other.

What does Phipps say about his book? Well, to the "...candidate physicist already committed, unbeknownst to himself, in the war of ideas, who chances to pick up this book—the Physicist-Errant, questing with lofty intellect above the struggle—is warned: I mean to get through your horsehide."

Had many of us read this book back at the time of publication, without benefit of the cold slap in the face of the Establishment reaction to Cold Fusion, we might have written off Phipps' book as simply a screed, the (loud) musings of a malcontent. But now the wisdom behind the humor and the jabs and arguments, behind the antiestablishmentarianism, is evident.

I can sum up no better than to quote Phipps himself from the epilogue: "My message in this book, which now draws to its close, is that if you believe the experts when they tell you your native wit and critical sense are worthless then in your own case you prove them right...but if you resist their browbeating their is hope in your case

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Dr. Thomas E. Phipps, Jr.
Photo by: James E. Corley

About *Heretical Verities* author, Thomas E. Phipps, Jr.
(Reprinted from the book)

Born in Champaign, Illinois in 1925, he was educated at Harvard in nuclear physics, worked during World War II in P.M. Morse's Operations Research Group in the Navy Department, and subsequently returned to Harvard to do an experimental thesis on molecular beam NMR under Norman Ramsey. His later career included a total of twelve years in the Pentagon, ten in systems analysis for the Navy and two in research management for the Department of Defense, as well as similar assignments at Navy laboratories in California and Maryland. In 1980, counting his debt to Caesar paid, he took an early retirement in order to resume his main interest, physics. A small laboratory was set up, shared with his father (an emeritus professor of physical chemistry at the University of Illinois) wherein they performed the experiments described in Chapter 7. He has thus exploited a rare opportunity for objective and unfettered probing of the state of modern science ... and this book is one of the results.

The book's dedication:

To my father, last of the "glass blowing" physical chemists, who lives for experiment.

Other praise for *Heritcal Verities*—endorsement printed on the book cover:

Phipps ... takes up his critique of relativity and quantum mechanics at roughly the point where Bridgman left off ... His basic claim is that both relativity and quantum mechanics have departed in dangerous ways from the methods that had led to steady progress over the years, and that much of the current theoretical confusion results from this fact ... In supporting this claim he must meet the problem of "clock synchronization" ... He does this in an ingenious way ... I accept his construction as valid, and profound ... I urge the reader to follow Phipps' construction in detail.

He goes on to deal with quantum mechanics ... His approach has the advantage of establishing a "Formal Correspondence" that works both ways, thanks to preserving the "initial state parameters" of the classical theory in the transition; in contrast Dirac throws these away ... So far as I know, Phipps was the first one to point out this obvious asymmetry between classical and quantum mechanics in such a way that the major problem of "measurement theory" dissolves ...

The third (mathematical) part of the book ... introduces hypercomplex function theory, which badly needs to be developed further—both physicists and engineers should agree enthusiastically. Phipps' treatment of discrete, infinite processes is eminently practical and well worth studying. His covering law approach to entropy and inference is again sound ...

This book ... is the life work of a very talented, dedicated, and profound scholar and physicist ... The audience he addresses ... are those "amateurs" and "dilettantes" concerned with the foundations of physics and mathematics who have not been blinkered or blinded by a narrow professional education, — in fact the modern counterpart of the audience Galileo addressed at the start of the scientific revolution ... My own hope is that this work will also be read by "professionals" who sincerely profess that they are open to new ideas ...

H. Pierre Noyes
Professor of Physics, Stanford University
Former Chief Theoretician, SLAC

Editorial continued from p.5

attacked one of the most important discoveries in the history of science. Let them wallow in their "fame."

And now about investments that are every bit as philanthropic as the above—for the socially conscious person who really wants to make lots of money and "do well by doing good." At the end of 1997, a quiet but very important milestone was reached—the formation and first formal closing of New Energy Partners, Limited Partnership (see press release on page 10).

A little over a year ago, in Issue #9 of this magazine, in this editorial column, I advocated the creation of an investment fund, "SuperPower, Inc." Our company, Cold Fusion Technology, Inc. intended to help launch such a fund. We have now been successful. Although the name may have changed (Dan Cavicchio thought Super Power, Inc. was a bit too grandiose), the concept is the same. ***New Energy Partners*** should accomplish most of the goals that I advocated for SuperPower, Inc.

Over the past year, Jed Rothwell, Dan Cavicchio, and I have examined many of the new technologies that we believe are part of the New Energy Revolution. What we found were a growing number of companies that had demonstrable products that were producing very high over unity effects consistently. These companies were and are rich with technology. What was missing was a capital fund to support and grow these companies, as well as to provide professional management direction. New Energy Partners will provide both.

We at *Infinite Energy* Magazine have done our best to promote the companies and technologies in this new field, and we will continue to do so in the future—no matter what additional philanthropic resources may come our way. However, words and publications can only do so much. We can not get around the old adage, "money talks." With *New Energy Partners*, the field now has a strong vehicle to move forward.

New Energy Partners is still looking for investors as it continues its due diligence into promising companies. Fortunately, they have attracted the investment interest of a number of well-financed institutions.

For a limited time, they are also accepting subscriptions from individuals for less than the minimum $250,000. We encourage all potential investors who meet the criteria of "accredited investors," to contact Dan Cavicchio for further information. We at *Infinite Energy* magazine are totally behind this concept as one very important way of supporting the field of new energy technologies, and we will be working closely with NEP by recommending promising companies and referring potential investors.

This investing will be philanthropy of the highest order—enlightened self-interest that will ultimately save lives and make you feel as warm in your *soul* as though you yourself had ignited the clean "burning," free-fuel new energy reactors to boil the water that saves many children in remote villages. Bless you all for your thoughts and best wishes.

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A Body of Evidence in Support of LENT (Low Eenery Nuclear Tansmutation)

NEWS RELEASE
The Cincinnati Group
December 31,1997

Appended are some elemental spectra generated by S.E.M. (Scanning Electron Microscopy). These tests were conducted without any Thorium Nitrate. Sodium metasilicate was used as the electrolyte. The handwritten number in the upper right corner identifies the scans.

The first scan is that of the zirconium electrode used in the experiment.

The second scan is that of the stainless steel (SS) electrode.

The third is the sodium metasilicate used in the test.

The fourth scan is an ‘after’ of the residue from a run using stainless steel and zirconium electrodes. The run was with AC current with varying voltage and amperage. It ran for about one hour. The main thing to note about this spectrum is the ratio of Na to Si. Dr. Robert Bass has put a query out on the Internet, on the Vortex forum, etc., to see if anybody would have a possible explanation of how the ratio could change. So far no real explanations have been given. A copy of the query is appended. In this spectrum there is also Mg, As, M, K, Ca and Ti that do not appear in any of the spectra of the cell components or the electrolyte. Considering that this is a closed-cell and this spectrum is of a S.E.M. at 100X, these are fairly large quantifies of elements.

The procedure for recovering the ‘after’ sample was to scrape the interior of the cell, including both electrodes, while still hot, using a sterile piece of SS. We then collected all of the liquid plus solids in a Pyrex dish, taking it to dryness at 200°F. When the sample was completely dry, we used the SS instrument to gently homogenize the residue. A sample of about 10 cm^2 of powder was then applied to a piece of carbon tape and placed on a carbon disk inside the S.E.M.

I was present at the time these test were being done. It was at a commercial lab, and because we were one of their most frequent customers, the S.E.M. operator would allow us some privileges, such as scanning the sample in 5 or 6 places to assure that the spectrum printed was a very accurate accounting of the elements present. I never sent samples; I always took them and observed the process. Please note that the Fe, Cr and Ni are from the SS electrode.

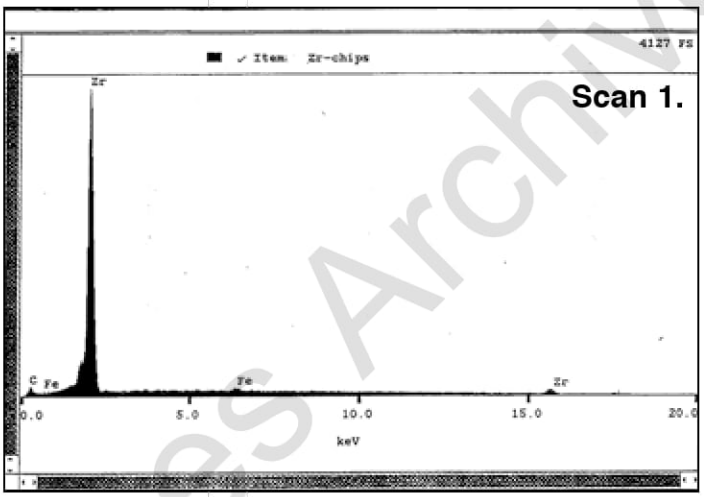
Scan number five is of a test that was very similar to scan four, the main difference being that we ran it for two hours. You can see that the Na is completely gone and that also there is now Zr, which is from one of the electrodes.

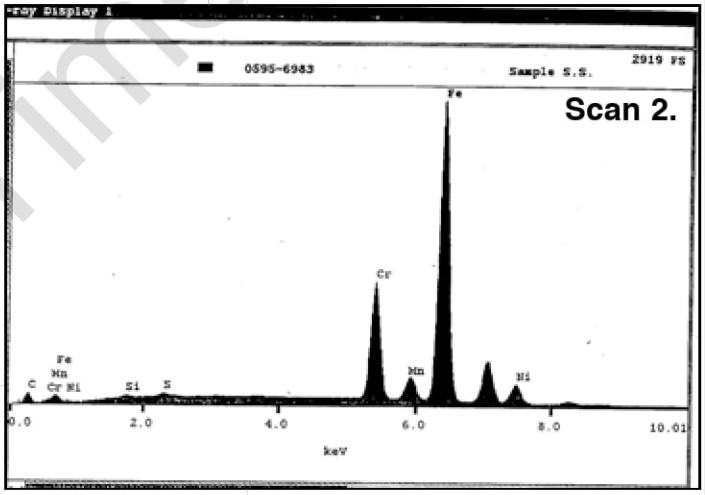
Dr. Elwood Brooks of the University of Cincinnati, an Electrochemist, tells us that this should “slam the door” on anything other than nuclear reactions. We are in the process of awaiting Dr. Brooks’ rerunning of these experiments in his lab. We intend on doing extensive investigation of these samples on an ICP/MS. With this we can do isotopic identification as well as quantitative analysis.

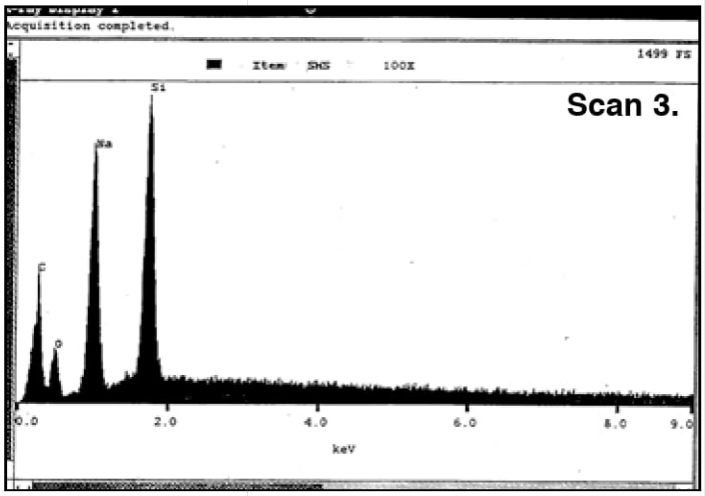
Stan Gleeson

Chris Tinsley much admired The Cincinnati Group, so it is our pleasure to put this photo of him here—the last one of him by me. Taken as he left Concord, New Hampshire for “darkest England” in 1996 ... for the last time.

— Photo by Gene Mallove







“Scientists will believe what you pay them to believe.”

— said a bit tongue-in-cheek by its author, Chris Tinsley

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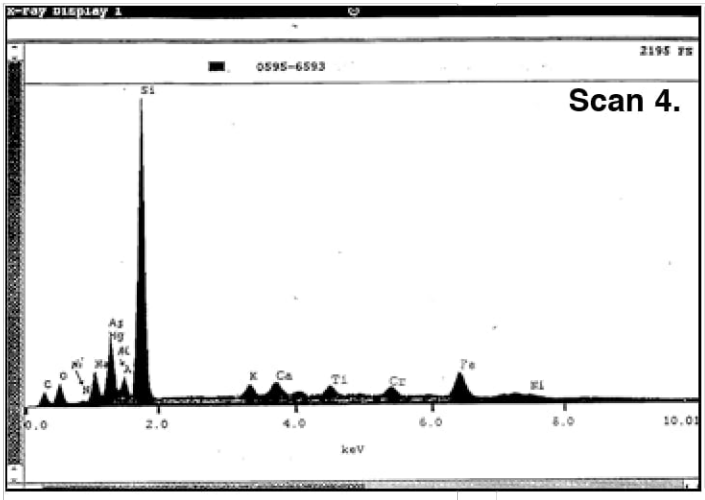

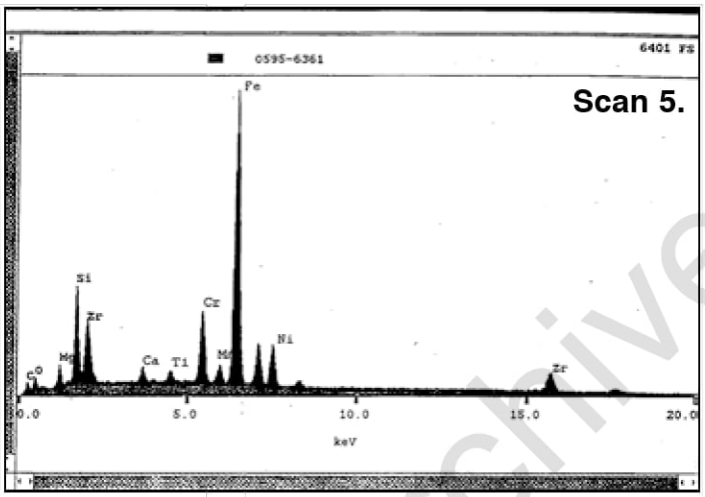

LENT-1 LATEST TECHNICAL RESULTS

TRENERGY, Inc.
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January 14, 1998

The Low-Energy Nuclear Transmutation reactor (LENT-1) is operated as follows:

1. The reactor is filled with 25 ml. of thorium nitrate in a distilled water solution such that 0.1 grams of thorium is present in the reactor cell.
2. The operational protocols are carefully followed (voltage, current, and temperature) for thirty minutes [Ed. Note: See *IE* Issue #13/14 for protocol].
3. Before- and after-processing samples of the electrolyte typically show that 4,300 parts per million of thorium reduces to less than 10 parts per million after processing.
4. There are two places where the thorium can accumulate: on the zirconium electrodes and in the precipitate. [Ed. Note: In these tests, we were informed that all electrodes are zirconium; there is no stainless steel in the inner cell.]
5. According to an Italian scientist (verbal communication) thorium cannot be stored in the zirconium metal. If the thorium is present on the zirconium electrodes, it must be on the surface of the electrodes.
6. It is well confirmed that over a series of experiments with the zirconium electrodes, the zirconium is eroded away and becomes the major part of the precipitates (probably as zirconium oxide).
7. Therefore, the thorium can only be substantially present in the precipitates.

An accurate chemical assay has been made on the amount of thorium in the pre-processed solution and in the post-processed solution. The pre-processed amount was 4,300 parts per million and the post-processed amount of thorium was 9.5 parts per million.

In a series of experiments using the LENT-1 zirconium electrodes, we have changed the stainless steel disk-electrode support with a threaded zirconium rod and a zirconium nut. The disk electrode is secured to the zirconium disk-electrode support by use of the zirconium nut. This assures a good electrical contact. Most of the zirconium support rod is covered with a Teflon sleeve.

Our observation of the operation of the LENT-1 reactor is that considerable erosion occurs on the half of the zirconium-disk electrode immersed in the electrolyte. Similar erosion takes place on the inner surface of the zirconium cylinder that constitute the other electrode for the system. Because of the continued erosion, it is obvious that the thorium cannot build up on the electrode surface. According to Dr. Bressani (or Dr. Del Guidice) in a conversation with Stan Gleeson, thorium cannot penetrate and be captured in a zirconium lattice.

Therefore, the thorium that is removed from the thorium nitrate solution in the LENT-1 cell electrolyte must be present in the precipitates after processing or else the thorium has been transmuted into a variety of other elements.

All of the precipitates from five experiments were combined into one sample and submitted [to a commercial laboratory] for chemical analysis. If all of the thorium had been deposited in the precipitates, there would have been 0.5 grams of thorium in the precipitates. The chemical analysis showed that 0.96 percent of the precipitates consisted of thorium or that 0.01286 grams of thorium had ended up in the precipitates. In addition, it was determined that there was also 0.0021 grams of copper in the precipitates.

The end result is that only 2.57% of the thorium that was put into the reactor over five experiments is accounted for in the precipitates. There will be a small amount of thorium on the surface of the zirconium electrodes. A new set of experiments is planned where the surface of the zirconium electrodes will be removed and subjected to a chemical analysis to determine precisely the amount of thorium. The current results are preliminary but are strongly supportive of the hypothesis that the thorium (and probably some zirconium) are being transmuted into other elements.

This series of experiments will be repeated beginning with a new zirconium cylinder and disk electrodes. We expect that such a series of experiments, especially as replicated by others, will be substantial evidence of the transmutation of thorium. A more complete analysis of the precipitates and of the post-processed electrolyte will be accomplished to determine what elements appear to be the primary ashes of the nuclear reactions of the thorium (and probably of a portion of the zIrconium).

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COLD FUSION TIMES

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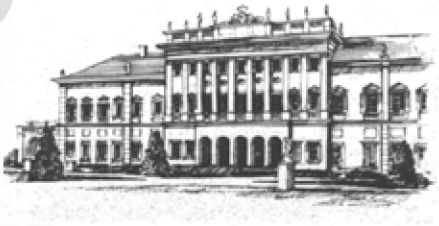

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ICCF-7 News
Vancouver, Canada April 19-24, 1998

ICCF-7 VANCOUVER "The Best Ever!"

September 26, 1997
Re: ICCF-7 April 19-24, 1998 Vancouver, Canada

Greetings!

ICCF-7 is now just a little over six months away, and it is time to make final plans.

Enclosed in this package are instructions for submitting official abstracts. Please return the yellow abstract form, by mail, to the ICCF-7 secretariat prior to November 1, 1997, in order to be considered for an oral or poster presentation at ICCF-7. A list of oral and poster presenters will be announced in mid-January, 1998.

A blue ICCF-7 registration form is also enclosed. Persons submitting abstracts must return this form with payment before November 1, 1997 along with their abstract. The conference registration fee is $450 USD until December 31, 1997, and $500 USD afterwards. A $75 USD supplemental fee enables spouses to attend the reception, banquet, and brunch. A refund of the registration fee is available to persons who submit abstracts that are not selected for either oral or poster status.

Everyone planning to attend ICCF-7 is expected to make their own, direct hotel arrangements on a first-come first-serve basis. Over 375 rooms have been blocked at five nearby hotels at special conference rates ranging from $90-185 USD per night. Additional rooms are available, if needed.

Additional information about abstract submittal, registration, and hotel bookings is enclosed along with a general Fact Sheet for ICCF-7. The website for ICCF-7 is now functional at:

http://www.ICCF-7.org

It is our intention to use the website as a major vehicle to disseminate information about ICCF-7. Please visit the website and provide suggestions for improvement. Watch for our next ICCF-7 mailing near the end of this year.

Best wishes,
Fred Jaeger
Organizing Chairman

ICCF-7 c/o ENECO, 391-B CHIPETAWAY, SALT LAKE CITY, UTAH 84108 USA,
PH (801) 583-2000. Fx (801) 583-6245 • jaeger@ENECO-USA.com

ICCF-7 FACT SHEET

PURPOSE

Welcome to the 7th International Conference on Cold Fusion (ICCF-7). The study of low energy induced nuclear reactions in solids has continued to mature, and many new and compelling scientific findings are becoming known. ICCF-7 provides a unique international forum for direct interaction among top scientists in the field. The quality and diversity of on-going research and commercial implications make ICCF-7 an important event that should not be missed.

DATE AND VENUE

April 19 - 24, 1998
Vancouver Trade & Conventional Centre
Vancouver, Canada

OFFICIAL CONFERENCE LANGUAGE

English

CONFERENCE SECRETARIAT

ICCF-7 Secretariat
c/o ENECO
391-B Chipeta Way
Salt Lake City, Utah 84108 USA

Phone (801) 583-2000 Fax (801) 583-6245 e-mail jaeger@eneco-usa.com ICCF-7 website http://www.ICCF-7.org

ICCF-7 INTERNATIONAL ADVISORY COMMITTEE (IAC)

Rotating Chairperson for ICCF-7:
Mr. F. Jaeger (USA)

Honorary Co-Chairpersons Emeritus:
Dr. Martin Fleischmann (UK)
Dr. Stanley Pons (France)

Committee Members:

Prof. T. Bressani (Italy)
Prof. H. Ikegami (Japan)
Mr. R. Machacek (Canada)
Dr. M. McKubre (USA)
Mr. K. Namba (Japan)
Prof. M. Okamoto (Japan)

Prof. G. Preparata (Italy)
Prof. N. Samsonenko (Russia)
Prof. C. Sanchez (Spain)
Dr. F. Scaramuzzi (Italy)
Dr. M. Srinivasan (India)
Prof. X.Z. Li (China)

ICCF-7 LOCAL ORGANIZING COMMITTEE (LOC)

Scientific Chairman: Prof. G. Miley - Univ. of Illinois
Organizing Chairman: Mr. Fred Jaeger - ENECO

Prof. P. Hagelstein - M.I.T.
Prof Y. Kim - Purdue
Dr. Y. Kucherov- ENECO
Mr. R. Machacek - Ontario Hydro
Dr. D. Nagel - Naval Research Lab

Prof. R. Oriani - Univ. of Minnesota
Dr. T. Passell - EPRI
Dr. Carol Storms - Los Alamos (retired)
Dr. E. Storms - Los Alamos (retired)
Dr. F. Tanzella - SRI

CALENDAR OF EVENTS

- September 26, 1997:
  Official call for one-page abstracts.
- November 1, 1997:
  Deadline for abstracts & registration for presenters.
- January 1, 1998
  Conference fee increases to $500 USD.
- January 15, 1998:
  Final notification of oral or poster status.
- January 30, 1998:
  Final amendments for abstracts to be published in ICCF-7 Program Manual &website.
- April 19, 1998:
  Deadline for final papers for inclusion in the ICCF-7 Proceedings (to be distributed summer '98)
- April 19-24th:
  ICCF-7 Vancouver, Canada

Daily program format:

CALENDAR

Third Russian Conference on Cold Fusion and Nuclear Transmutation
October 1—8, 1995
Sochi, Russia

Power-Gen '95
(CETI cell demo)
Anaheim, California
December 5-7, 1995

New Ideas in Natural Sciences
June 17-22
St. Petersburg, Russia

1996 International World Energy System Conference
June 19-21, 1996
Toronto, Canada

2nd Low-Energy Transmutation Meeting
College Station, Texas
Sept.13-14, 1996

ICCF6—Sixth International Conference on Cold Fusion
October 13-18, 1996
Hokkaido, Japan

Building Energy—Insuring a Sustainable Future
March 12-15, 1996
(Sponsor: Northeast Sustainable Energy Association)
Radisson Hotel and Conf. Center
Cromwell, Connecticut

INTERNATIONAL SYMPOSIUM ON NEW ENERGY
(Sponsor: Academy for New Energy)
May 23-26, 1997
Denver, Colorado

International Tesla Society Meeting
July 10-13, 1997
Colorado Springs, CO

Cold Fusion Conference in Italy at Asti
November 27-30, 1997
Asti, Italy

ICCF7—Seventh International Conference on Cold Fusion
April 19-24, 1998
Vancouver, CANADA

ICCF-7 VANCOUVER "The Best Ever!"

New Energy Times Archive

ICCF-7
VANCOUVER
"The Best Ever!"

08:30 - 09:10 Invited presentation of the day's topic.
09:10 - 09:30 Follow-up discussion and questions.
09:30 - 09:55 Oral presentation #1 *
09:55 - 10:20 Morning break
10:20- 10:45 Oral presentation #2
10:45 - 11:10 Oral presentation #3
11:10 - 11:35 Oral presentation #4
11 :35 - 12:00 Oral presentation #5
12:00 - 13:30 Lunch
13:30 - 15:00 15-20 oral previews of poster presenters (3-5 min/ea)
15:00 - 15:30 Afternoon break
15:30 - 17:30 Poster presentations
19:30 - 20:30 Evening workshops; three nights

* Regular oral presentations will be 20 minutes followed with a 5 min question and answer period. All oral presenters in the morning will also host a poster follow-up session in afternoon.

ICCF-7 HOTEL POLICY

All ICCF-7 activities will be held in a government owned trade & convention center called One Canada Place on downtown Vancouver's scenic waterfront. ICCF-7 organizers have negotiated special conference rates for a limited block of rooms at each of five downtown hotels that are within convenient walking distance to the conference center. Special ICCF-7 group rates are applicable from Saturday, April 18th through Saturday, April 25th.

All ICCF-7 participants are responsible for directly booking and paying for their stay at the hotel of their choice on a first-come first-serve basis. Early hotel bookings are strongly encouraged because there are only a limited block of rooms available at each hotel, and all conference hotels will incrementally release unreserved rooms for general public sale at 90, 60, and 30 days before the conference. Reservations generally require credit card payment for your first night's stay. Full payment of the balance is required at checkout.

HOTEL SUMMARY

(actual prices are subject to exchange rates at time of payment)

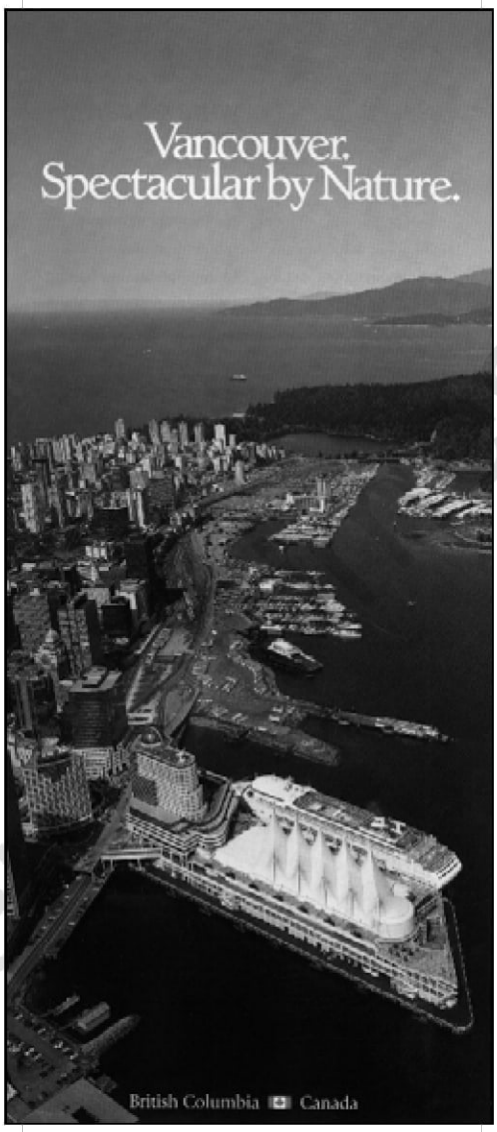
PAN PACIFIC HOTEL is a luxurious hotel that sits directly on top of the ICCF-7 conference center. A simple elevator trip will take you to all ICCF-7 activities.Daily price is approximately $185 USD for single or double occupancy, including taxes. For reservations phone 1-800-937-151 5 or fax (604) 895-2469 mention "cold fusion" group code. 75 rooms are initially blocked for ICCF-7.

THE WATERFRONT HOTEL is across the street from the ICCF-7 conference center, and is directly connected by an underground shopping arcade with restaurants. Daily price is approximately $175 USD for single or double occupancy, including taxes. For reservations phone 1-800-441-1414 or fax (604) 691-1999 mention "KO419" group code. 100 rooms are initially blocked for ICCF-7.

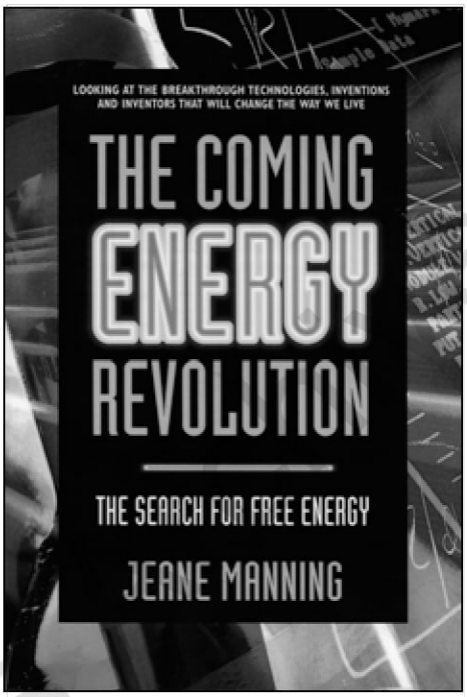
DAYS INN is an economical hotel two blocks from the conference center. Daily price is approximately $90 USD for a one-bed room and $100 for a two-bed room, including taxes. For reservations phone (604) 681-4335 or fax (604) 681-7808 mention "ICCF-7" group code. 20 singles and 20 doubles are initially blocked for ICCF-7.

RENAISSANCE HOTEL is three blocks from the conference center overlooking the Burrard Inlet Harbor. Daily price is approximately $140 USD for single or double occupancy with city view and $160 USD for single or double with harbor view. For reservations phone 1-800-468-3571 or fax (604) 689-4358 mention "ICCF-7" group code. 60 rooms are initially blocked for ICCF-7.

HYATT REGENCY HOTEL is four blocks (7-10 minute walk) from the conference center. Daily price is approximately $165 USD for single and $185 for double occupancy, including taxes. For reservations phone 1-800-233-1234 or fax 1604) 643-5812 mention "ICCF-7" code. 100 rooms are initially blocked for ICCF-7.



If you are a science journalist, *before* you write about cold fusion—*do your homework and GET THE FACTS!* Subscribe to *Infinite Energy* Magazine P.O. Box 2816 Concord, NH 03302-2816



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The author, Frank Znidarsic, has a B.S. in Electrical Engineering from the University of Pittsburgh, has an Associate in Science from Saint Francis College, and is a registered professional engineer in the state of Pennsylvania.

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Four (4) two-hour VHS video tapes—**8 hours total viewing**— are available as a set, or individually. These were only slightly edited from professionally taken video footage of the day-long Cold Fusion session at MIT on January 21, 1995. The tapes include the following material:

TAPE#1

Dr. Eugene F. Mallove
(Cold Fusion Technology, Concord, NH)
"Cold Fusion and New Energy Technology - An Overview"

Dr. Peter Graneau
(Northeastern University Center for Electromagnetic Research) "Anomalous Forces in Water Plasma Explosions"

TAPE#2

Buford ("Ray") Conley
(MIT, graduate student, Dept. of Aero/Astro Eng.)
"Light Water Excess Heat Experiments"

Fred Jaeger
(ENECO, Salt Lake City)
"Patents and Commercialization"

Professor Peter L. Hagelstein
(MIT Dept. of Electrical Engineering and Computer Science) "Cold Fusion: What We Know and What We Don't Know"

TAPE#3

Professor Peter Hagelstein
(CONTINUED from TAPE #2)
"Cold Fusion: What We Know and What We Don't Know"

Professor Keith Johnson
(MIT Dept. of Materials Science and Engineering)
"Progress in the Theory of Excess Heat" *and Excess Heat*- The Movie, now being made by Hollywood!

James L. Griggs
(Hydro Dynamics, Inc., Rome, Georgia, USA)
"The Hydrosonic Pump: Excess Power and Other Effects"

TAPE#4

Bertil Werjefelt
(PolyTech(USA), Hawaii)
"Energy from Magnetic Materials and Magnetic Fields"

Dr. Eugene F. Mallove
(Cold Fusion Technology, Concord, NH)
Concluding Remarks

The tapes include the speakers' presentations as well as question and answer sessions. There is footage of the Hydrosonic Pump under test as well as close-up footage of rotor surface melting effects. Bertil Werjefelt shows footage of experiments in his own laboratory. There are scenes of Japanese researchers from Sumitomo, Hitachi, and other companies and universities now involved in their claimed extraction of energy from magnetic materials. These efforts are now said by these researchers to be proceeding toward commercialization. Actual experiments are seen in progress. The tapes are VHS cassettes in NTSC format and range from 120 to 127 minutes each.

To order **the full set of four, two-hour tapes**, please send check or money order to Cold Fusion Technology for **$79.95 plus $5.00 shipping and packing, within U.S. and Canada.** [For other foreign orders, please replace the $5.00 shipping fee with $30.00 for air shipment.] To order *individual tapes*, please specify which tape(s). Please send check or money order for $25.00/tape, plus $3.00 shipping and packing if only one tape, or $5.00 total if more than one tape. Tapes are Copyright 1995, Cold Fusion Technology.

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1996 Cold Fusion & New Energy Symposium (at the Cambridge Marriott, 1/20/96)

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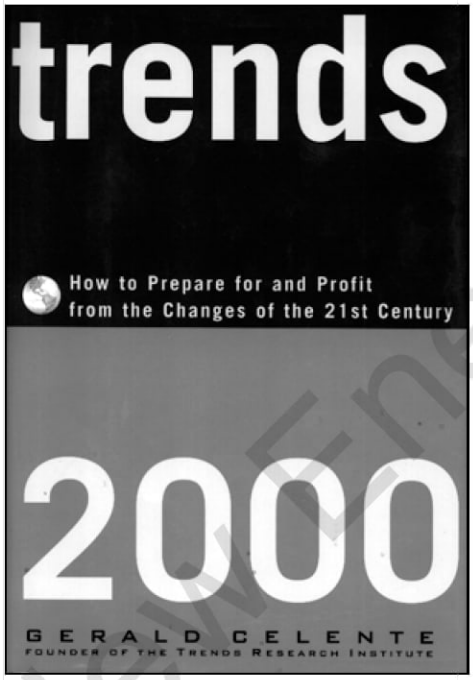
Forward-Looking Book, *TRENDS 2000*

Prominently Cites the Coming Energy Revolution....

In part by reading *Infinite Energy* magazine, noted trend-forecaster Gerald Celente of the Trends Research Institute in Rhinebeck, New York, concludes that: "The dream of 'free energy' is about to become technological reality and the single biggest investment opportunity of the 21st century—its ramification will extend to practically every aspect of human and planetary life." This is stated prominently on the jacket of Celente's 1997 book, *TRENDS 2000*, often seen in the Business sections of bookstores. The 336-page book, now in paperback edition, is widely distributed as a Warner Book (ISBN 0-446-51901-4).

In the "Renaissance 2001" section of the book, on page 305, there is a sub-section titled (appropriately!), "Infinite Energy, " which briefly discusses cold fusion and



other discoveries that will put OPEC out of business. He calls the emerging energy revolution "on the order of the discovery of fire." Then in the text it states boldly the following "TRENDPOST," or major highlighted projection and recommendation:

"The energy revolution will be the single biggest investment opportunity in the twenty-first century. Its ramifications will extend to practically every aspect of human and planetary life. To profit from the trend, potential investors should begin familiarizing themselves with the field thoroughly and immediately, and keep abreast of developments before they become official (Recommended reading: *Infinite Energy* magazine, PO Box 2816, Concord, NH 03302. Tel: 603-228-4516.)"

All we can say is, "Wow, thank you, Gerry!"— And, of course, we couldn't agree with you more! Many, many dozens of formerly non-involved persons have become subscribers to Infinite Energy due to this increasingly influential book. Mr. Celente appears regularly on national and international television—CNN, etc.—and in the print media. The prominent US Newspaper, *USA Today*, often runs his year-end projections, and last year was no exception. On December 11, 1997 (page 9D), Anita Manning of the paper featured Celente's 10 top predictions for 1998 that appear in the current edition of his *The Trends Journal*. The "Free Fuel" trend was reported: "Celente predicts 'the first major public announcements of an impending energy revolution that promises to free the world of its dependence on fossil fuels.' The new energy forms will come out of developments in cold fusion and 'zero point energy,' the extraction of energy from apparent vacuum."

The quarterly *Trends Journal* may be obtained for $185 (US, others add $7/year) at:
The Trends Research Institute
PO Box 660, Rhinebeck, NY 12572-0660
914-876-6700 • Fax 914-758-5252
http://www.trendsresearch.com

We reprint, with permission, his pace-setting and totally on-target energy revolution article:

FREE FUEL

1998 will see the first major public announcements of an impending energy revolution that promises to free the world of its dependence on fossil fuels.

A global energy source that is virtually operationally cost free, pollution free and portable is on the horizon. And society stands on the verge of a major paradigm shift on the scale of the discovery of fire, the invention of the wheel, the discoveries of Galileo and the Industrial Revolution.

Energy-rich nations, multinational oil companies, utilities and all businesses, big and small, dependent on coal oil and natural gas for their chief form of income will begin to recognize that fossil fuels are in danger of becoming as obsolete as the whale-oil lamp.

The power that fueled the industrial Age (including nuclear) will be replaced by new energy forms that will fuel the new millennium.

Though well-known "green" sources (solar, wind, geothermal) will play a role in the energy revolution, as will high tech, energy saving improvements to existing fossil-fuel burning devices, the major advances are more likely to come from the esoteric, little known and less-understood phenomena of "cold fusion" and "zero point energy."

LIGHTEN UP

Despite the current atmosphere of opposition, disbelief and derision prevailing among the scientific establishment, these processes will gain credibility in 1998 as increasingly successful results of new laboratory experiments are published and major manufacturers announce plans to develop commercial applications.

Cold fusion is the name applied to processes in which an electric current is passed through an electrolyte, producing radiation-free nuclear reactions at temperatures far below the millions of degrees required for hot fusion. Fusion at these lower temperatures is held to be theoretically impossible by most physicists.

In principle, the cold-fusion process can cheaply and safely harness the immense power inherent in the atom. Some cold-fusion experiments have generated untold amounts of energy while simultaneously eliminating in hours the radioactivity of materials that under natural conditions would require billions of years to eliminate (U.S. Patent No. 5672259).

Zero-point energy (also called "over-unity energy") refers to the extraction of energy and heat from an apparent vacuum. A ZPE device produces vastly more energy than it consumes. Inventors believe they are tapping into the energy of space. Physicists acknowledge this energy exists, and several peer-reviewed theoretical papers sug-

New Energy Times Archive

papers suggest it can be extracted, but many scientists are still not persuaded such extraction is possible.

Meanwhile, the only reports coming to the general public about the latest in alternative energy are news stories about gasoline-electric hybrid cars and renewed commitments to develop solar power.

With technical articles in specialized science journals acknowledging successful laboratory experiments, major companies, while not publicly discussing their plans, are known to be seriously looking into commercial ZPE and cold fusion for product development. And venture capitalists have set up funds for research and development of promising applications.

Trendpost: When the first commercial applications reach the market — reportedly by decade's end, probably in the form of water heaters—the gold rush will be on. Those drawn to high-risk, high-gain investments will do well to monitor the free - energy trend. (See *Infinite Energy* magazine, P.O. Box 2816, Concord, NH 03302; 603-228-4516; www.infinite-energy.com)

—End of the *Trends Journal* article—

The bug must be catching.....

Several days after Celente's mention in *USA Today*, a headline story appeared in *USA Today* (December 18, p.6E) "Future Shock: Global changes ahead after 2020." The newspaper had asked members of its *Investment Roundtable* "what sweeping global changes they expect— an industry that is going to blossom, a demographic or political force that is going to be manifest, or change in the way capital or labor will be assembled and allocated—by the year 2020 and beyond."

Hugh Johnson, one of the *USA Today* panelists is the chief investment office of First Albany in Albany, NY, as well as chairman and president of First Albany Asset Management. Says *USA Today*, "He is one of the most widely quoted veterans on Wall Street."
Johnson is quoted, in part:

"Watch hydrogen. That's all I would say. Just keep the word "hydrogen" in mind. I don't know if anybody knows about it.

Well, we do!..and all other readers of *Infinite Energy*, including, and especially Gerald Celente!

Show your colors.....

One of our dedicated subscribers, Bob Horst, sent us this photo of his personalized automobile license plate frame slung around his natural gas meter! Now that's the spirit! Bob, are you trying to send your

gas company a message or what?

Dr. Robert ("Bob") W. Horst wrote a fine piece of us back in *Infinite Energy* Issue #2 in 1995, "Cold Fusion in 2001 and Beyond: Lessons from High Tech." Dr. Horst was then Technical Director at Tandem Computers. He has about 22 years experience in high technology, including 22 U.S. patents to his name.

Received from our Russian colleagues...a report.....

The Fifth Russian Conference on Cold Nuclear Transmutation of Chemical Elements

The Fifth Russian Conference on Cold Nuclear Transmutation of Chemical Elements (RCCNT-5) took place in Dagomys near Sochi ('OLYMPISKY' Tourist Hotel) on September 29-October 5, 1997).

The Conference was organized by the RCCNT-5 Organizing Committee and Cold Fusion Interdepartmental Coordination Council (CFICC) governed by Vice President of the Russian Academy of Sciences academician O.Nefedov. It was held under the aegis of the Russian Academy of Sciences, Nuclear Society of Russia, Russian Physical Society, D. I. Mendeleev Russian Chemical Society, M. V. Lomonosov Moscow State University, Russian Friendship University, Moscow State Technical University (MADI).

The Russian Foundation for Fundamental Research was the sponsor of the Conference. The Russian Institute of Interdepartmental Information and the EuroAsian Physical Society provided publishing the Proceedings of the 3rd and 4th Russian Conferences on Cold Fusion and Nuclear Transmutation (Dagomys-95, Dagomys-96) and the programs of the 5th Russian Conference on Cold Nuclear Transmutation of Chemical Elements.

50 participants represented Russia, Ukraine, Belarus, USA, Japan, China and Taiwan.

Russia was represented by the main research teams permanently working in the field of cold fusion since its discovery (for 8 year period), and by new groups from Moscow, Podolsk, Ekaterinburg, Tomsk, Volgodonsk, Krasnodar, Dubna, Omsk, etc.

42 reports (12 on theory, 26 on experiment, 4 on applications and reviews) were presented at the Conference, and a video of one experiment was shown.

In spite of the fact that this problem has almost no financial support in Russia, the experimental results presented for discussion showed accumulation of new results and growth of their statistical and systematic reliability, accuracy and reproducibility.

On the strength of all the experimental material obtained in the period after the previous conference, new results have been received, which confirm the occurrence of the following basic nuclear products in cold nuclear reactions: neutrons (Bazhutov, Rusetsky, Romodanov et al.), tritium (Romodanov, Rusetsky), charged particles - ,B, P (Bazhutov, Rusetsky), γ-quanta (Lipson, Bazhutov, Romodanov, Karabut, Koldamasov), new isotopes and elements (Lipson, Savvatimova, Karabut, Li, Mizuno), helium (Arata), heat (Savvatimova, Karabut, Kanarev, Arata, Chen).

It is noteworthy, that in experimental research along with traditional methods of reaction stimulation, new methods appear: ultrasound liquid cavitation (Bazhutov), infrared irradiation (Li), neutron irradiation (Lipson).

Theoretical reports showed the development of knowledge on possible mechanisms of cold nuclear transmutation (Samsonenko, Sapogin, Bazhutov, Chubb, Li, Shadrin, Filimonov, Rodionov, etc.). The choice lies with the further experimental research.

The participants of the Conference confirmed the importance of the further investigations on CT [cold transmutation], and emphasized the great contribution of the Russian science into this field, and expressed hope that financing of this research is possible in the nearest years

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which will lead to a breakthrough both in experimental results and in theoretical explanation of the new department of physical chemistry—Cold nuclear transmutation of chemical elements, and to raise it to the level of new technologies.

Chairman of CFICC, Co-chairman of RCCFNT-5. academician
V.Kazarinov

Deputy Chairman of CFICC, Co-chairman of RCCF:NT-5 Organizing Committee
Yu. Bazhutov

Member of CF International Organizing Committee, Deputy Chairman of RCCFNT-5 Organizing Committee
N. Samsonenko

BURIAL IS NO ANSWER!

The following memorandum was circulated to members of the U.S. House of Representatives
—signed by ***five*** Congressmen:

Congress of the United States
October 28, 1997

H.R. 1270 IS NOT THE ANSWER TO THE NUCLEAR WASTE DILEMMA

Dear Colleague:

We will soon vote on H.R 127O, the Nuclear Waste Policy Act of 1997. We urge you to join us in opposition to this misguided bill. H.R. 1270 may respond to the short-term economic and public relations needs of the nuclear utility industry, but it does a disservice to our obligation to find real solutions to the nuclear waste dilemma.

Few will deny that the nation's nuclear waste policy has been a failure. Many of the failures can be traced back to 1987, when Congress made a political decision to limit our search for a permanent repository for nuclear waste to Yucca Mountain in Nevada and hope that our political decision would prove technically supportable. As might be expected, the results were less than successful.

Instead of correcting the errors of the past, however, H.R. 1270 repeats them. We are once again placing political expediency ahead of public health and safety. If H.R. 1270 passes, we will be no closer to a permanent solution to the high-level waste dilemma than we were when the Nuclear Waste Policy Act first passed in 1982. Specifically, H.R. 1270 would:

- Mandate the construction of an unnecessary "interim" storage facility for high-level nuclear waste at Nevada Test Site before studies of Yucca Mountain are complete.
- Open the door to the greatest nuclear waste transportation project in human history by sending 95 percent of the nation's waste radioactivity on the roads and rails through 43 states in casks that are governed by inadequate safety standards that do not even require compliance testing of full-scale models.
- Slash environmental safeguards by carving loopholes for nuclear waste disposal from the National Environmental Policy Act, eliminating licensing standards for a permanent repository, and forbidding the Environmental Protection Agency from issuing health-based radiation release standards.
- Trample on state sovereignty by granting the federal government broad license to preempt state and local laws designed to protect their citizens from the risks of nuclear waste transportation.

H.R. 1270 is rife with the short-sighted thinking that helped create the current nuclear waste dilemma. Please join us in opposing this flawed effort.

Sincerely,
Edward J. Markey
Elizabeth Furse
Dennis J. Kucinich
John E. Ensiga
Jim Gibbons

AND.... A LETTER TO THE U.S. ENERGY SECRETARY:

Mr. Frederico F. Peña
U.S. Department of Energy
Forrestal Building, Room 7B138
1000 Independence Avenue, SW
Washington, D.C. 20585

Dear Secretary Peña:

I am writing at the behest of my constituent Stephen Kaplan who has expressed great urgency concerning the direction the US Department of Energy has taken and is presently taking in processing of nuclear waste.

Mr. Kaplan reports to me that research on low temperature nuclear reactions indicates that there is a possibility nuclear waste can be transmuted into inert substances, alleviating the need for encapsulation and long term storage.

Mr. Kaplan writes: "At least three companies working in this field have developed processes arising out of low temperature nuclear reaction research which apparently leads to the transmutation of radioactive materials in[to] inert substances. Dr. James Patterson, head of CETI, was issued US Patent #5,672,259 on September 30, 1997 for a "System with electrolytic cell and method for producing heat and reducing radioactivity of a radioactive material by electrolysis." The Cincinnati Group is currently marketing a Low Energy Nuclear Transmutation Kit (LENT-tm) with a money back guarantee that it will produce verifiable transmutations at low energy. Finally, Trenergy, Inc. has developed the Fox-Jin-Bass process for plasma injected transmutation."

Enclosed are articles from ***Infinite Energy*** magazine which Mr. Kaplan feels describes these two processes, the CETI Power Cell and the Cincinnati Group's Low Energy Transmutation Kit.

The First Congressional District which I represent is downstream on the Columbia River from Hanford, the largest nuclear waste site in the nation. We know that radioactive materials are presently leaching into the groundwater and towards the Columbia. A long term, safe solution to neutralize these mountains of nuclear waste is essential to our national security.

I would appreciate knowing if the Department of Energy has been made aware of these proposed methods for dealing with nuclear waste and if so, the extent to which this potential method has been studied by the DOE. It would appear such methods would permit remediation of nuclear waste on-site, obviating the need for encapsulation and transportation to underground storage, along with all the potential hazards involved in such operations.

I look forward to hearing from you and will be pleased to pass any pertinent materials you might have on your investigations into low temperature nuclear reaction research to Mr. Kaplan

Sincerely, **ELIZABETH FURSE**
Member of Congress
1st District, Oregon

Cold Fusion Need Not Apply!

The small business SBIR proposal information that the U.S. Dept. of Energy passes out to guide research proposal applications, specifically ***excludes*** cold fusion.

This language is taken from
<http://wwofge.er.doe.gov>:

"Grant applications pertaining to cold fusion will be declined, as will those pertaining to other fusion energy concepts not based specifically on magnetic or inertial confinement of plasmas for the purpose of producing energy/electricity for non-defense purposes."

In other words, GO AWAY, we hot fusion people can't be bothered with any new ideas—not even other *hot* fusion ideas! This is disgusting, perverted tyranny!

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Jed Rothwell reviews an important new book....

Kakuhenkan, jyouon kakuyuugou no shinjitsu

Nuclear Transmutation, the Reality of Cold Fusion

by Dr. T. Mizuno

Kougakusha, 1997, Japan, 230 pages, 23 references

Tadahiko Mizuno, one of Japan's best cold fusion scientists, has written a short book about his work and his personal experiences. It is the best account yet written about the daily work of a cold fusion researcher. It gives you a sense of what the job feels like. The book is written in a breezy style for the general reader. A few sections have movie-script style dialog. ("You better get over here; we're seeing a new peak!") Other sections are more technical, particularly a discussion of Conte's quantum mechanical theory of cold fusion. The book is primarily about experiments performed by Mizuno and Akimoto at the University of Hokkaido, but it covers other people's work, especially Oriani and Ohmori.

The Prehistory of the Discovery

Mizuno has often talked about the prehistory of cold fusion. Most great discoveries are visited and revisited many times before someone stakes a permanent claim. People sometimes stumble over a new discovery without even realizing where they see. Mizuno did his graduate and post graduate work on corrosion using highly loaded metal hydrides. His experiments were almost exactly like those of cold fusion, but they were performed for a different purpose. In retrospect, he realized that he saw anomalous events that may have been cold fusion. At the time he could not determine the cause, he did not imagine it might be fusion, and he had to leave the mystery unsolved. No scientist has time to track down every anomaly. I expect many people saw and disregarded evidence for cold fusion over the years. Mizuno makes a provocative assertion. He says that long before 1989 he wondered whether the immense pressure of electrolysis might produce "some form of fusion." He says, "This kind of hypothesis would occur to any researcher studying metal and hydrogen systems. It is not a particularly profound or outstanding idea. It never occurred to me to pursue the matter and research this further." He appears to downplay the role of Pons and Fleischmann. Perhaps he exaggerates when he says "any researcher" would think of it, but on the other hand Paneth and Peters and others did investigate this topic. It has been floating around the literature for a long time. Pons and Fleischmann deserve credit because they did far more than speculate about it. They succeeded in doing the experiments to prove it. Perhaps cold fusion is self-evident in a way that many great discoveries are. An ordinary genius finds an obscure and difficult truth which remains obscure even after he publishes, except to other experts. A superlative genius makes a discovery that few other people imagined, yet which everyone later agrees is obvious in retrospect. When T. H. Huxley learned of evolution, he reportedly said: "why didn't I think of that?!?"

A Serious Experiment

Within days of the 1989 announcement Mizuno set to work on a "crude, preliminary" experiment. He built the cell in single afternoon, which is in itself astonishing. His purpose was to detect neutrons, which he along with everyone else in 1989 assumed would be the principal signature of the reaction. Months later it became clear that heat is the principal signature and neutrons appear sporadically. The neutron flux is a million times smaller in proportion to the heat than it is with hot fusion. His colleague Akimoto, an expert in neutron detection, soon convinced him that the instrumentation must be improved and the cell must be moved to a well-shielded location before meaningful results might be obtained. The underground laboratory housing the linear accelerator, right next door on campus, was the ideal spot for the experiment, but it is hardly an ideal place for people. It is dark, dank, and unheated in winter, as Mizuno well knew from years of doing graduate work there. After weeks of operation, the experiment showed slight signs generating 2.45 MeV neutrons. Mizuno decided to get serious.

And here we learn what a real scientist is made of. While the rest of the world rushed to judgement, Mizuno buckled down and began a second "serious" experiment. The preparations took eight

Cold Fusion Technology, Inc. Will Be Publishing this Book in English. — A Note to Readers from Jed Rothwell

This month my contribution to the magazine is short because I am translating the book into English. In the next issue we will include some extracts, and we hope to publish the entire work in English in a book form soon.

Mizuno sent me the text of the book in Japanese via e-mail. The version he sent is longer than the book. The Japanese publisher cut some technical details to make it easier for the general reader. He cut many sarcastic and controversial comments. I will be pleased to put both back into the English version. For example, the published version briefly mentions an incident during the 1989 brouhaha. Two professors called a press conference behind Mizuno's back. They bandied about his preliminary results as proof that cold fusion does not exist. In the unpublished version he describes this with a few pages more detail. He talks about "two professors, A and B, who were near retirement age." He says they read one paper (P&F) and heard about Mizuno's data, and the next thing he knew camera crews showed up on campus. The Distinguished Professors explained to the press why cold fusion is impossible. He says (loosely translated): "the cold fusion 'study group,' which in reality consisted of me, myself and I, and later Akimoto" was threatened with immediate termination. The department head was out of the country. When he returned and heard about this fiasco he was shocked and saddened that professional scientists would judge a serious issue on the basis of one paper and one incomplete, crude, preliminary experiment. He rescued the research by allocating some of the department contingency funding. Weeks later, after Professors A and B and the television cameras had left the scene, the experiment began to show signs of a nuclear effect.

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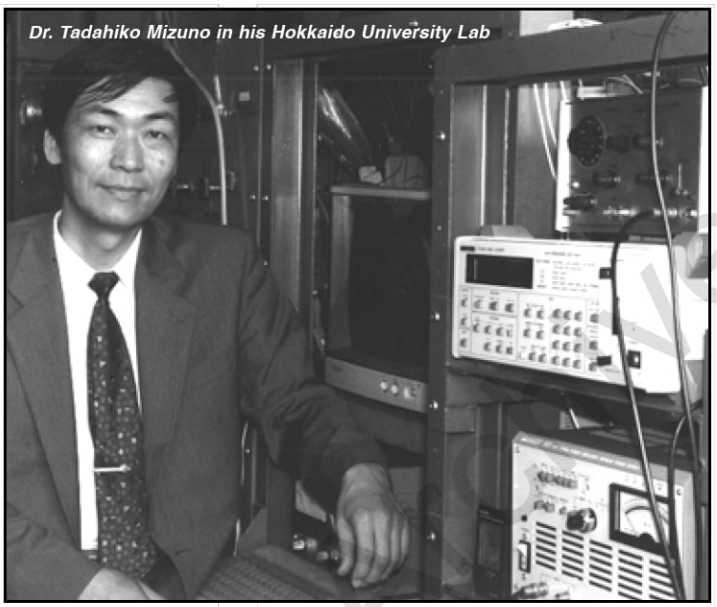
months. Mizuno and a graduate student worked long days building and testing the cell, and preparing the anode, cathode, electrolyte, and controls. They planned to run at 100°C and 10 atmospheres of pressure, so they ran pressure tests at 150°C and 50 atmospheres, improving the seals and connections until they saw no significant pressure decline for days. Finally they were ready to begin the first test run. The hysteria was long past. The press and the establishment had dismissed cold fusion. Real experiments by people like Mizuno were getting underway. When these tests were finished and documented, a year or two later, they constituted definitive proof of tritium, excess heat, and transmutation. It is tempting to think that the tragedy of cold fusion boils down to . . . a short attention span. If only Nature and the newspapers, the DoE and the American Physical Society understood that you cannot do a research project in a few weeks, they would have withheld judgement until Mizuno, Fritz Will, Melvin Miles and others published in 1990 and 1991.

A One-man R&D Program

In person, Mizuno is charming, self-depreciating, optimistic and brimming with ideas. In the book he describes the dark side of the story: the frustration, the boredom, the endless guerrilla war with scientists and journalists who want to stop the research, the fruitless battles to publish a paper or be heard at a physics conference. Research means years of hard work which must often be done in appalling circumstances: in an unheated underground laboratory, late at night, in Hokkaido's Siberian climate. Experiments must be tended to four times a day, from eight in the morning until eight at night, seven days a week, without a holiday or a weekend off. He describes these travails, but he does not dwell on them, or the controversy and politics. He revels in the fun parts of cold fusion: the discovery, the sense of wonder, the rewards. Mizuno does not mope or worry. He gets to work, he does experiments, he teaches and encourages students. The first 5,000 copy printing of this book sold out quickly. Mizuno was thrilled because, he told me, "undergrads are buying it, and calling me with questions." He and I wanted to move ICCF-6 [October 1996] out of the isolated resort hotel, back to town, and into the grubby Student Union meeting hall on campus. We wanted to open up the conference free to any student. When the engineering and physics majors drift in and realize what we are up to, cold fusion will take off.

Despite all the troubles, Mizuno remains confident that we will succeed in the end. The research will be allowed, papers will be published, rapid progress will be made. Others, like Fleischmann, are deeply pessimistic. Some of the best scientists in this field, including Storms, are deeply discouraged with the constant struggle and expense. They sometimes tell me they are on the verge of quitting. But Mizuno has never flagged, has never doubted, and has never lost hope. As Storms says, "We must have hope, we have no other resources in this field."


Dr. Tadahiko Mizuno in his Hokkaido University Lab

Mizuno wants to make practical devices. He wants to improve reproducibility and scale-up. He talks about the scientist's obligation to give society something of value. He and Dr. Dennis Cravens are the only cold fusion scientists I know who say that. He succeeded in replicating the original Pons and Fleischmann palladium cold fusion in three experiments, but it was difficult and the reaction proved impossible to control, so he did not see much future in it. Instead of trying to improve the original experiment by repeating it many times with minor variations, the way McKubre, Kunimatsu and others have attempted, Mizuno decided to try other materials. He worked with proton conductors (solid state devices) for several years and made good progress. He is trying other materials and other approaches. He is a one-man R&D consortium. Some may criticize him for trying too many things and spreading himself too thin. As I see it, Mizuno is doing his share. The rest of the world is to blame for not following his lead. After all, he worked on proton conductors for years, he published detailed information in professional, full-length papers, and he assisted Prof. Oriani at the University of Minnesota by fabricating a batch of proton conductors for him (a week of difficult labor on Oriani's behalf). No other scientist is as cooperative, willing to share data, and as willing to assist others replicate. If Mizuno has left jobs unfinished, others should have taken up these jobs.

Mizuno concentrates on the rewards, the progress, the heady sense of excitement, the breathtaking possibilities. If progress has been slow, it has been real, and the scope of the research has broadened immeasurably. In 1989 we thought we had stumbled on one isolated uncharted island. It turned out we have discovered a whole new continent. No wonder it is taking longer than we expected. Over the years I have asked many scientists where cold fusion may be taking us and how big the discovery might be. Only Martin Fleischmann has shown a deep understanding of how many ramifications it may have.

Circling in on the Answer

Mizuno describes few moments of epiphany. There are moments of excitement, but most of the triumphs are long expected, and a good result does not mean much until you make it happen again, and again after that. There are few revelations. The scientists do not suddenly grasp the answer. They gradually narrow down a set of possibilities. Often the same possibilities are examined, discounted, and then reconsidered years later. In recent years, Mizuno, and Prof. John Bockris and others have increasingly focused on so-called "host metal transmutations," that is, nuclear reactions of the cathode metal itself. The cathode metal was inexplicably neglected for many years. The term "host metal" is misleading. It was an unfortunate choice of words. It implies that the metal acts as a passive structure, holding the hydrogen in place, cramming the deuterons or protons together. The metal is a host, not a participant. The hydrogen does the work. Now, it appears the metal itself is as active as the hydrogen. The metal apparently fissions and fusions in complex reactions. Now the task is to think about the metal, and not just the hydrogen. Theory must explain how palladium can turn itself into copper with peculiar isotopes.

One of the few "Eureka!" events in this book is the moment when Mizuno and Ohmori saw the scanning electron microscope images of the beautiful lily-shaped eruptions on the surface of Ohmori's gold

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cathodes (see book cover photo). This was visual proof that a violent reaction takes place under the surface of the metal, vaporizing the metal and spewing it out. Later, these vaporized spots were found to be the locus of transmutation. Around them are gathered elements with an isotopic distribution that does not exist in nature. The only likely explanation is that these isotopes are the product of a nuclear transmutation.

Mizuno describes the wrong directions he has taken, the dead ends, the mistakes. For years he ignored the most important clue: the host metal transmutations. He did not check the composition of the used cathodes. After his first big success produced tritium and spectacular heat after death, he opened the cell to find the cathode was blackened by something. He thought it must be contamination, and he was disappointed that his painstaking efforts to exclude contamination had failed. After puzzling over it for a long time he scraped the black film off the cathode with glass, and prepared the cathode for another run. Years later that he realized that this black film was probably formed from microscopic erupted structures similar to those on Ohmori's cathodes. He says in retrospect he was throwing away treasure. Even Mizuno, an open-minded, observant, and perceptive scientist, has to be hit over the head with the same evidence many times before he realizes it is crucial. Other people are worse. Mizuno was blind for a long time; other cold fusion scientists remain blind to this day. They are unwilling to do simple tests that might reveal the nature of the reaction. IMRA, under the leadership of Stanley Pons is a sad example. Informed sources say IMRA has never performed an autoradiograph!

Money Problems

Mizuno describes how he frets and struggles to reduce expenses. He worries about the consumption of heavy water, at $8 or $10 per day. He does not reveal in the book why these expenses bother him so much: most of the money comes out of his own pocket. Over the years the research has cost him tens of thousands of dollars, which is a great deal of money for a middle class Japanese family. Cold fusion research consumes a constant flow of new equipment. The Japanese scientific establishment and the university barely tolerate this research. They allocate a small research budget. (Most U.S. universities and national laboratories would not allow the research at all.)

Mizuno describes the dank, underground laboratory, but he does not mention that his own laboratory is the size of a broom closet and so crammed with equipment you can barely fit in the door. The roof leaks. A large sheet of plastic is suspended over the corner of the room, funneling the rain water down the sink and away from the computers, meters, power supplies and complex, delicate, beautiful handcrafted experimental apparatus, made of aluminum, stainless steel, platinum, gold and silver.

Synopsis

The book has seven major sections:

1. Prologue

The First International Low Energy Nuclear Reactions Conference at Texas A&M. This conference was organized by Bockris and focused on transmutation of the host metal. This emerges as the theme of the book. In Mizuno's opinion it is the key to cold fusion.

2. The Curtain Rises on Cold Fusion

Mizuno's background and his early experiments which, he realizes in retrospect, may have produced nuclear effects. At the time that possibility never occurred to him. He does not try to take credit for "discovering" cold fusion decades ahead of his time, like Paneth and Peters in the 1920s. He does show that major discoveries are, in a sense, there for the taking.

3. First Replication

The impact of the Pons-Fleischmann announcement. Soon after hearing the news in 1989, Mizuno puts together a "quickie" replication experiment. With help from his colleague Akimoto, an expert in neutron detection, he improves the neutron detection and moves the experiment to an underground laboratory to reduce background noise. Meanwhile, in the world at large "chaos ensues," as hundreds of scientists attempt to replicate Pons and Fleischmann without adequate knowledge of the experiment or training in electrochemistry, and hundreds more attack it. The brouhaha spreads to the campus of Hokkaido University, where a pair of professors call a press conference behind Mizuno's back. They parade his preliminary data in front of the cameras, claiming that it "proves cold fusion does not exist." Weeks later, the experiment apparently begins to produce neutrons.

4. A Serious Replication

Mizuno decides to do a real experiment, and we separate the men from the boys. While others continue to run around in a tizzy and the U.S. DoE rushes to judgement, Mizuno and a graduate student settle in for the long haul of doing a real experiment. Eight months later they finished fabrication, preparation, pressure testing, purifying the electrolyte, and all of the other tasks that Mizuno has been doing for twenty years. They are ready to begin their first serious cold fusion experiment. Over the next months it produces tritium, excess heat, massive heat after death, and —he learns years later—massive host metal transmutations: by isotope shifts and more of some elements than can be explained by contamination.

5. Experiments with Solid State Proton Conductors

After years of working with palladium and heavy water, Mizuno and others decide to try new materials and techniques. Inspired by a scientific supply catalog, Mizuno experiments with solid state proton conductors. He attracts the attention of Dr. Richard Oriani. They begin a fruitful collaboration. Mizuno supplies Oriani with proton conductors, which Oriani tests in a Seebeck calorimeter. Some valuable help from others. An expert in computers gives Mizuno a hand and speeds up the research tremendously. Mizuno discusses the vital need for more cooperation, more openness. Masao Araki, a top executive at one of Japan's largest corporations steps in to help the research.

6. New Developments

At the ICCF-4 conference Hawaii, Mizuno finds out that another scientist at Hokkaido, Dr. Ohmori, who has a laboratory in the building next door, is working on gold electrode-light water cold fusion. An academic will sometimes travel halfway around the world before he will talk to the professor next door. Mizuno and others gradually realize that the transmutations in the metal are the key to understanding cold fusion. The metal is not a passive lattice that supports reactions between the hydrogen atoms. It is an active participant.

7. What is the Cold Fusion Reaction

Mizuno speculates on the physics of the cold fusion reaction. He is impressed by a theory from Elio Conte, on quantum mechanics by biquarternions. He outlines some of the basics of quantum mechanics and shows that Conte's theory is a small departure from mainstream, conservative physics. This section includes a fascinating discussion of pressure from electrolysis. Mizuno cites a 1980 paper by Maoka & Enyo showing that the average pressure on a cathode is much lower than Pons and Fleischmann claimed in 1989, but microscopic areas on the cathode near dislocations and surface features can have much higher pressure. It may be as high as 10^{-23} atmospheres, easily as high as the pressure at the core of a neutron star.

Mizuno visits Russia and Korea, and reports on new trends from Russia and Ukraine.

In this section he describes the lily-shaped structures seen in the scanning electron microphotograph on the front of the book. The metal is vaporized, it erupts, and it is flash frozen. It contains gold plus platinum, iron and other elements believed to be the product of transmutations.

Scattered through the chapters in chronological order are brief reviews of the ICCF conferences. They begin to sound like a recurring bad dream: "[ICCF-4] was held on the Hawaiian island of Maui at the Lahina Hyatt Regency, a typical resort hotel. It lasted four days . . . Two hundred fifty people attended from some 13 countries and in its own way it was a sparkling success. But I got the impression that there were no truly outstanding results, and with no big changes from the previous meeting. . . . It was clear that the major research groups, like Fleischmann and Pons, Jones, Fritz Will and Bockris, had nothing new to report, and they were merely repeating what they said at ICCF-2 and ICCF-3." Repeat for ICCF-5 and 6.

The book includes a short description of the SRI accident and what caused it, and a variety of other background and historical information. It is copiously illustrated with many good photographs, including a group of 19 color photos and graphs. It has a short bibliography.

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SMALL IS PROFITABLE

Why Our Bigger-is-Better Electricity System's Days Are Numbered

Reprinted with permission from the *Rocky Mountain Institute Newsletter* (Spring 1997), Volume 13, Number 1
[Rocky Mountain Institute, 1739 Snowmass Creek Road, Snowmass, Colorado 81654-9199 www.rmi.org]

Last summer, two massive power outages blacked out millions of homes and businesses in the western United States. Electric utilities insisted these were freak events, but pledged to take steps to prevent future occurrences.

In each case, the ostensible cause was a minor failure at a time of peak demand. But ultimately the blackouts trace back to this: today's centralized electricity systems were designed for a world that went out with the Studebaker.

They date from a time, in the immediate postwar period, when electricity demand was growing rapidly, supply was getting cheaper, heavy industry was in vogue, and nuclear power was the bee's knees. All of which favored big power plants and big, high-voltage transmission grids, all centrally planned and controlled.

Consider today's realities. Demand is growing more slowly and much less predictably. The cost of supplying it from giant coal and nuclear stations didn't continue to decline as expected, owing to whopping cost overruns, environmental regulations, local opposition, and the albatross of nuclear power. Meanwhile, the cost of small-scale alternatives, such as photovoltaic panels, wind turbines, and fuel cells is steadily coming down.

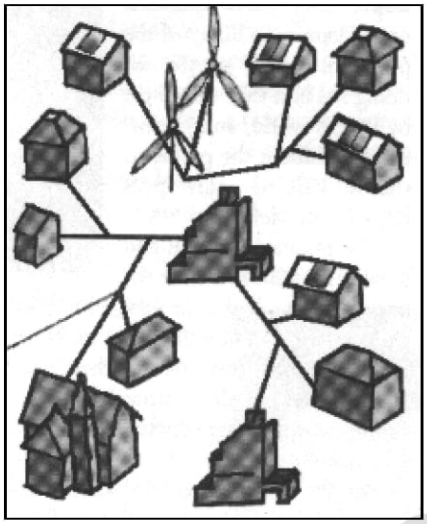
Gee, maybe it's time to re-examine our assumptions.

Three years ago, RMI started doing just that with a grant from The Pew Charitable Trusts to study "distributed resources" — an alternative approach to delivering electricity with smaller, decentralized power sources (see the Summer 1994 *Newsletter*). This winter, after various interruptions to pursue promising spinoffs in other fields, researcher André Lehmann and research director Amory Lovins teamed up to write the most thorough synthesis to date on distributed resources. Their study, *Small Is Profitable: The Hidden Economic Benefits of Making Electrical Resources the Right Size*, will be published by RMI this summer.

A Question of Scale

The thinking behind distributed resources challenges several basic assumptions that produced our present electricity system.

First, it turns the concept of economy of scale on its head, emphasizing *mass production* instead of *unit size*. Centralized electricity generation is based on the reasonable-sounding proposition that the bigger the power plant, the cheaper the capital cost per kilowatt and the higher the efficiency. Unfortunately, a few big plants can easily prove more expensive to build than a lot of smaller ones, because they require more customized design, are prone to higher cost overruns, take longer to build, entail premium siting costs, attract stronger opposition, and are often less reliable.



In contrast, distributed resources such as photovoltaics and wind turbines exploit the benefits of mass production. Building power plants more like cars than cathedrals moves labor from the field, where productivity gains are small and diminishing, to the factory, where they're huge—and where quick incorporation of improvements can compress many generations of technology into a short time.

A second tenet underlying distributed resources is that energy sources should be of a scale appropriate to their end uses. Would you try to run a smelter with a bunch of wind turbines? It makes as little sense to power a house with a 1,000-megawatt power plant.

In *Small Is Beautiful*, E.F. Schumacher's point wasn't that everything should be small, but rather that everything should be the right size for the job and that, incidentally, most jobs are small. RMI's research indicates that that's certainly the case with jobs involving electricity: three-fourths of households use less than 1.5 average kilowatts, and three-fourths of businesses less than 10 average kilowatts. Being well matched in scale to those modest-sized jobs, distributed resources are uniquely portable, flexible, diversifiable, controllable, and accountable to end users.

The question of appropriate scale is an extremely important (though often overlooked) theme that runs through RMI's work on everything from cars to communities.

Costs and Benefits

But the most powerful logic behind distributed resources is that they avoid many of the hidden costs of centralization. The main purpose of *Small Is Profitable* is to bring those costs—and the corresponding benefits of distributed resources—to the electric utility industry's attention.

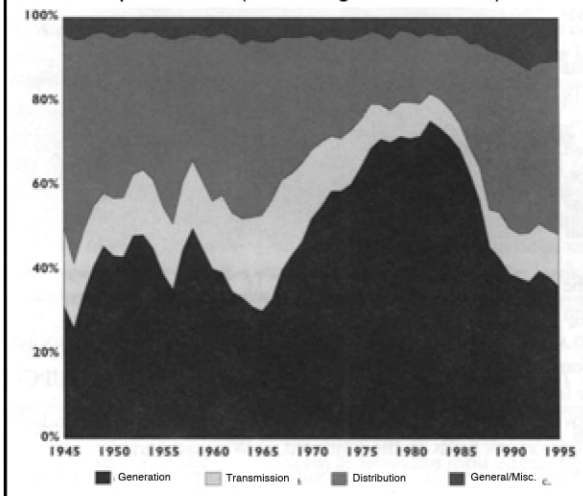
Take risk. If someone offered to sell you a junk bond paying 8 percent or a Treasury bill paying the same rate, which would you choose?

That's a silly question, you say. The market would never offer the same rate of return on two investments with such different risks. Or would it?

Actually, that's pretty much the way utilities—most of which are monopolies, and are only indirectly accountable to their cus-

GRID? WHAT GRID?

Composition of Investor-Owned Utilities' Construction Expenditures (Excluding Nuclear Fuel)



Most electric utilities don't fully value the benefits of distributed resources because they remain focused on the cost of generating electricity, not delivering it. Yet as this graph shows, utilities have historically invested more in the grid than in power plants—except during the nuclear fad of the '70s and early '80s—and the grid's share is on the rise. Source: EEI Historical Statistics and Statistical Yearbook 1996.

New Energy Times Archive

tomers—have made investment decisions for years. They face an array of risks, many of them quantifiable: fuel-price volatility, forecasting uncertainty, regulatory uncertainty, technical failure, and so on. Amazingly, they seldom factor any of these risks into the economics of their decision-making processes.

In many ways, small-scale technologies entail less risk. They can be installed quickly, minimizing many of the economic, planning, and construction uncertainties that plague big power plants, which typically take a decade or more to plan and build. Being smaller and cheaper, they diversify financial risk among many units, in many locations, and among various technologies. Being modular, they enable utilities to increase capacity in small increments as needed, rather than making billion-dollar, bet-the-company commitments. Being dispersed, they reduce delivery costs and make more efficient use of the existing grid.

Small-scale doesn't automatically mean less risky. Proper risk accounting favors a diverse portfolio of technologies, including a certain component of small-scale ones. That way, the utility covers its bets whatever happens.

Risk vs. Reliability

Distributed resources also lower technical risks—that is, they increase reliability. About 95 percent of power failures occur in transmission or distribution. But generating power closer to where it's used—on the roof or in the backyard, ideally—reduces transmission and distribution distances, and therefore the risk of failure. (Incidentally, efficiency is the ultimate distributed resource, because it "generates" electricity right where its used.)

Last summer's blackouts raised questions about the reliability of centralized electricity systems, which, after all, are based on an old-fashioned philosophy that favors quantity over quality. They weren't designed to deliver the sort of premium-quality power that high-tech users increasingly demand. The restructuring of the electricity industry, which is opening the door to third-party marketing of electricity, is likely to make customer satisfaction all the more important.

(Distributed resources also have their technical drawbacks. For example, more localized electricity sources means more connections to the grid, which can result in more localized outages. Fortunately, the automation technologies needed to reverse this risk are getting cheaper all the time, and their spread will tend to favor distributed resources, partly by helping power to flow both ways.)

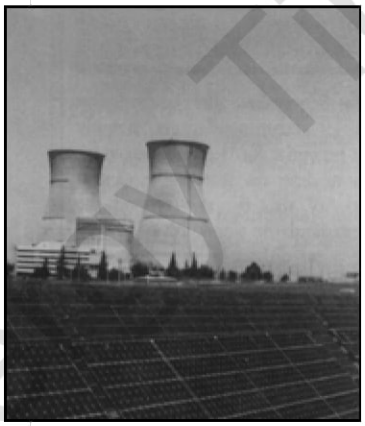
A Quiet Revolution

The diseconomies of giant power plants have been apparent (though not widely acknowledged) for 20 years. The average size of new plants in the United States peaked in the late 1970s, and the past decade has seen a rapid shift to smaller, cheaper, more modular combined-cycle gas turbines. Non-utility electricity generation is even on the rise, for the first time in a century.

The era of the giant thermal power plant has quietly ended, says *Small Is Profitable*, and a quiet revolution of smaller, dispersed resources is already under way.

Several utilities—notably California's Sacramento Municipal Utility District—are already working to diversify their portfolios and disperse their resources. The prospect of industry restructuring, for all its drawbacks, is forcing all utilities to behave more competitively, and that's likely to encourage them to assign market values to the benefits of distributed resources.

The Electric Power Research Institute, the electricity utilities' own think tank, has begun to study distributed resources on a technical level, and *E SOURCE*, RMI's electric-information subsidiary, is at work on a strategic issue paper examining the policy implications of distributed resources. Some consulting services now specialize in advising utilities on distributed resources.



George Turner, SMUD
An early proponent of distributed resources, the Sacramento (Calif.) Municipal Utility District erected a grid-connected photovoltaic array on the grounds of its abandoned Rancho Seco nuclear powerplant. Residential PVs make its grid more stable.

So interest in the subject is finally catching up with its importance. There's only one thing missing: synthesis. Virtually all industry studies of distributed benefits have focused on one or another benefit in isolation, ignored or underestimated the full range, and treated many data as trade secrets.

Small Is Profitable evaluates about 50 types of distributed benefits, and concludes that, properly valued, they make renewable energy sources a better deal than conventional ones in nearly all new supply, and in many cases where existing supply needs replacement.

A Better World

Some of the biggest benefits of distributed resources, though hard to measure in dollars, are environmental and social ones.

A full accounting of risk and other factors levels the playing field between all forms of electricity supply. Doing that reveals renewable energy and efficiency to be cost-effective in many more situations than was previously thought. That should speed their uptake and help offset the many problems associated with using non-renewable energy. As volume production of renewables increases, unit costs will come down, making them cost-effective in even more situations, and hastening the inevitable transition from an economy based on fossil fuel and nuclear power to one powered by the sun.

Like so much of RMI's work, *Small Is Profitable* describes a better world, but one that doesn't exist. Not yet, anyway.

Utilities are understandably reluctant to change the way they do business without proof that it's worked for somebody else. That's why the final section of *Small Is Profitable* profiles a half-dozen utilities that have begun to experiment with distributed resources. None is the long-awaited "distributed utility," but their efforts affirm the late economist Kenneth Boulding's dictum that "Whatever exists is possible."

The transformation of the electricity industry will be measured in decades, not years. Power plants and transmission grids are among the most enduring types of infrastructure. Decisions in this field, once made, live on for generations.

All the more reason, then, to ensure that the electricity system we build today isn't a white elephant for our children.

(END of RMI article)

Editor's Comment:

We certainly wish to thank The Rocky Mountain Institute for allowing us to reprint this article, which is basically consistent with the distributed power philosophy implicit in the Cold Fusion and New Energy Revolution. We hope that RMI will pay attention to the world-changing science and technology (it has *not* done so in the past) chronicled in *Infinite Energy*—RMI receives our magazines regularly, gratis. We beg to differ with one statement in the RMI article, "efficiency is the ultimate distributed resource." No, we need more energy, not less. Efficiency is a noble goal, but it is *not* the ultimate one. The goal of the New Energy Revolution is clean, virtually free energy— infinite energy— for all the peoples of the world. Above all, energy that is not interruptible by the vagaries of weather or the cycle of night and day. ***—EFM***

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Dr. Randell L. Mills' Hydrogen Catalytic Energy Patent Has Been Granted Acceptance in Australia.....

No. 668678

Commonwealth of Australia

Letters patent
Patents Act 1990

STANDARD PATENT

I, Bruce Ian Murray, Commissioner of Patents, grant a Standard Patent with the following particulars:

Name and Address of Patentee:
Hydrocatalysis Power Corporation, Great Valley Corporate Center 41 Great Valley Parkway Malvern Pennsylvania 19355 United States Of America

Name of Actual Inventor: Randell Lee Mills
Title of Invention: Energy/matter conversion methods and structures
Application Number: 91343/91
Term of Letters Patent: Twenty years commencing on 20 November 1991

Priority Details:
Number Date
626496 12 December 1990
Country
UNITED STATES OF AMERICA

Dated this 25 day of September 1996

B.I. MURRAY
COMMISSIONER OF PATENTS

AU9191343

PATENT ABRIDGMENT
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Acceptance No. 668678

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ENERGY/MATTER CONVERSION METHODS AND STRUCTURES
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626496 12.12.90 US UNITED STATES OF AMERICA
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Prior Art Documents
EP 568118

Claim
1 .
A method of extracting energy from hydrogen comprising the steps of: contacting a transition catalyst with hydrogen under conditions whereby said hydrogen undergoes a transition to an energy state lower than n=1 and energy is released from said hydrogen, wherein n is the energy state of an electron in a hydrogen atom and said transition catalyst is a catalyst for catalyzing the transition of hydrogen top an energy state lower than n=1.

[Ed. Note: —There were no claims #2 and #3 listed.]

4. An apparatus for providing the release of energy, comprising:
a vessel capable of containing fluids;
a source of hydrogen atoms;
an effective amount of a transition catalyst for catalyzing the transition of a hydrogen atom to an energy state lower than n=1, wherein n is the energy state of an electron in said hydrogen atom; and
means for contacting said transition catalyst with said hydrogen in said vessel under conditions whereby said hydrogen atom undergoes a transition to an energy state lower than n=1 and releases energy.

OPI DATE 08/07/92 **APPLN. ID** 91343 / 91
AOJP DATE 20/08/92
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Applicant and inventor: MILLS, Randell, Lee [US/US]; 805 Esteile Drive, Suite 110, Lancaster, PA 17601 (US).

Agents: WEST, William, K., Jr. et al.; Cushman. Darby & Cushman, Eleventh Floor, 1615 L Street, N.W., Washington, DC 20036 (U5).

Designated States: AT, AT (European patent), AU, BB, BE (European patent), BF (OAPI patent), BG, BJ (OAPI patent), BR, CA, CF (OAPI patent), CG (OAPI patent), CH, CH (European patent), CI (OAPI patent), CM (OAPI patent), CS, DE, DE (European patent), DK, DK (European patent), ES, ES (European patent), FI, FR (European patent), GA (OAPI patent), GB, GB (European patent), GN (OAPI patent), GR (European patent), HU, IT (European patent). JP, KP, KR, LK. LU. LU (European patent), MC, MG, ML (OAPI patent) MN MR (OAPI patent), MW, NL NL (European patent, NO, PL, RO, SD, SE, SE (European patent) SN (OAPI patent), SU+, TD (OAPI patent), TG (OAPI patent).

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Title:
ENERGY/MATTER CONVERSION METHODS AND STRUCTURES

Abstract
Methods and structures to release heat energy from hydrogen atoms by stimulating their electrons to relax to a quantized potential energy level below that of the ground state via an electrochemical reactant(s) of redox energy resonant with the energy hole which stimulates this transition. Methods and structures to conform the electronic energy of the hydrogen atoms and the redox energy of the electrochemical reactant(s) to enhance the hydrogen electronic transition rate where the source of hydrogen atoms is aqueous electrolytic production on the surface of a cathode.

ENERGY/MATTER CONVERSION METHODS AND STRUCTURES

Related Applications

BACKGROUND OF THE INVENTION

As a result of the erroneous assumptions and incomplete or erroneous models and theories, the development of useful or functional systems and structures requiring an accurate understanding of atomic structure and energy transfer has been inhibited. The Schrodinger equation, for example, does not explain the phenomenon referred to as "cold" nuclear fusion, anomalous heat release and trace tritium production of certain electrolytic cells having a palladium cathode and a lithium electrolyte, which comprises the present invention. Thus, advances in materials and energy/matter conversion is largely limited to laboratory discoveries having limited or suboptimal commercial application.

SUMMARY OF THE INVENTION

A novel atomic theory is disclosed in The Grand Unified Theory, Mills and Farrell, Science Press, 1990, and in previous U.S. patent applications entitled "Energy/Matter Conversion Methods and Structures," filed on April 21, 1989 and April 28, 1989 which are incorporated by reference.

This invention relates to methods and apparatus for releasing energy from atoms as their electrons are stimulated to relax to a lower energy level and small dimensions by providing an energy hole resonant with this transition according to a novel atomic model. The present invention further comprises methods and structures for repeating this shrinkage reaction to cause controlled nuclear fusion and shrunken atoms to provide new material with novel properties such as high thermal stability.

According to this model the electron of the hydrogen atom is a two dimensional spherical shell where each point on the shell follows a geodesic orbit about the central nucleus. For the ground state, the electric field is a radial central field inside the spherical shell and zero outside, where the radius of the shell is the Bohr radius, a_o. At this radius, the electron is nonradiative and force balance exists between the central field of the proton and the electron. Excited states of hydrogen arise from the capture of a photon(s) inside this spherical shell, a spherical resonator cavity. For the excited modes, the electric field is the sum of the ground state field and a time harmonic solution of LaPlace's equation in spherical coordinates. The electric field is non zero inside of an expanded resonator cavity where the radius at which nonradiation and force balance is achieved is an integer multiple of the Bohr radius. The photons which excite these modes have energy $[1/n_1^2 - 1/n_2^2]$ x 13.6 eV where n_1 and n_2 are integers and $n_2>n_1$.

The radical ground state field can be considered as the superposition of Fourier components. The removal of Fourier components of energy n/2 x 27.2 eV where n is an integer gives rise to an electric field inside spherical shell which is a time harmonic solution of LaPlace's equations in spherical coordinates. In this case, the radius at which force balance and nonradiation are achieved is a_o/n where n is an integer. In decaying to this radius a total energy of $[(n + 1)^2 - n^2]$x13.6 eV is released. This energy release process is the present invention.

In a preferred embodiment an energy hole of approx-

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imately 27 ev is provided by an electrochemical reactant(s), electrocatalytic couple, which causes heat to be released from hydrogen atoms as they are stimulated to relax to a quantized-potential energy level below that of the ground state where the energy of the redox reaction of the electrocatalytic reactant(s) is resonant with that required to effect this transaction, an energy hole of about 27 ev. The source of hydrogen atoms is the production on the surface of a cathode during electrolysis of water.

The conforming of the resonance between the redox energy of the electrocatalytic couple, the source of the energy hole, and the electron orbital energy, the sink of the energy hole, causes an increase in the hydrogen shrinkage reaction rate with a concomitant enhancement of the heat power. The reaction rate net power output can be increased by this mechanism as well as others by controlling the temperature, the electric field of the electrolysis cell as a function of time, the electrocatalytic couple which provides the energy hole, the counterion of the electrocatalytic couple, the pH of the solution, the surface area of the cathode, the current density of the cathode, the material composition of the cathode, the pressure of the hydrogen gas boundary layer between the surface of the cathode where the reacting hydrogen atoms are generated and the solution which contains the electrocatalytic couple. This can be achieved by applying vibration or ultrasound to the cathode and/or electrolytic solution and by the use of an electrolysis circuit where the current is intermittent. Further energy can be released by using deuterated or tritiated water which can undergo nuclear fusion.

Brief Description of the Drawings

FIGURE 1 is a schematic drawing of an energy reactor in accordance with the invention.

FIGURE 2 is a schematic drawing of an electrolytic energy cell reactor in accordance with the invention.

FIGURE 3 is a schematic drawing of a power controller for use in the reactor of' FIGURE 2

FIGURE 4 is a waveform diagram of the voltage waveform, of the circuit of FIGURE 3.

FIGURE 5 is a waveform diagram of the current waveform of' the circuit of FIGURE 3

Disclosure of the Invention

According to a first embodiment of this invention there is provided a method of extracting energy from hydrogen comprising the steps of:

contacting a transition catalyst with hydrogen under conditions whereby said hydrogen undergoes a transition to an energy state lower than n=1 and energy is released from said hydrogen, wherein n is the energy state of an electron in a hydrogen atom and said transition catalyst is a catalyst for catalyzing the transition of hydrogen to an energy state lower than n= 1.

According to a second embodiment of this invention there is provided an apparatus for providing the release of energy, comprising:

a vessel capable of containing fluids;

a source of hydrogen atoms;

an effective amount of a transition catalyst for catalyzing the transition of a hydrogen atom to an energy state lower than n=1, wherein n is the energy state of an electron in said hydrogen atom; and

means for contacting said transition catalyst with said hydrogen in said vessel under conditions whereby. said hydrogen atom undergoes a transition to an energy state lower than n=1 and releases energy.

DETAILED DESCRIPTION OF THE INVENTION

Theory

For the hydrogen atom, the radius of the ground state orbitsphere is a_o. This orbitsphere contains no photonic waves and the centripetal force and the coulombic force balance. Thus,

$$\frac{m_e v_1^2}{a_o} = \frac{e^2}{4\pi\varepsilon_0 a_0^2} \qquad (8.1)$$

It was shown in the Excited States of the One Electron Atom Section (all References herein the Theory Section apply to The Grand Unified Theory by Randell Mills and John Farrell, 1990) that the electron orbitsphere is a resonator cavity which can trap electromagnetic radiation of discrete frequencies. The photon potential functions are solutions of LaPlace's equation. The photons decrease the nuclear change to 1/n and increase the radius of the orbitsphere to na_o. The new configuration is also in force balance

$$\frac{m_e v_n^2}{na_o} = \frac{e^2/n}{4\pi\varepsilon_0 (na_o)^2} \qquad (8.2)$$

We propose, however, that the orbitsphere resonator can trap photons which increase the nuclear charge and decrease the radius of the orbitsphere. This occurs, for example, when the orbitsphere couples to another resonator cavity which can absorb energy -- we call this the absorption of an energy hole. The absorption of an energy hole destroys the balance between the centrifugal force and the increased central coulombic force. As a result, the electron is pulled toward the nucleus. And, if another allowed state (that obeys the boundary conditions) were not available, the electron would plunge into the nucleus.

Now, recall that for the He^+ ion (Z = 2; a one-electron atom) an allowed state exists at 0.5 a_o. It can be shown that if a ground state hydrogen atom emits a photon of which 27 eV, two photons are created—one is ejected and one remains in the orbitsphere. The photonic wave in the orbitsphere creates an effective charge at the orbitsphere such that the electron experiences an effective charge of +2e, and establishes a new centripetal/coulombic equilibrium at $r_{1/2} = 0.5\ a_o$. That is, the orbitsphere shrinks from $r_1 = a_o$ to $r_{1/2} = 2$.

$$y = \frac{-Z_{eff}e^2}{4\pi\varepsilon_0 r_{1/2}} = \frac{2x2e^2}{4\pi\varepsilon_0 a_0} = -4 \times 27.178\,eV = -108.70\,eV \qquad (8.3)$$

The kinetic energy of the shrunken orbitsphere is -2 V, or T = 54.35 eV. The ground-state hydrogen atom has an (net) energy of -13.59 eV and the final hydrogen atom has an (net) energy of -54.42 eV (same as He^+), and ΔE = -40.83 eV for the reaction

$$H\ (Z_{eff}=1;\ r_1=a_o) \rightarrow H\ (Z_{eff}=2;\ r_{1/2} = 0.5\ a_o)\ . \qquad (8.4)$$

That is, about 27 eV is lost with the absorption of the energy hole and about 14 eV is given off after absorption of the energy hole.

It is shown below that the resonance energy hole of a hydrogen atom which excites resonator modes of radial dimensions m+l is

$$m \times 27.2\ eV, \qquad (8.5)$$

where m = 1, 2, 3, 4, ...

After resonant absorption of the hole, the radius of the orbitsphere, a_o, shrinks to $a_o/(m+1)$ and after p cycles of resonant shrinkage, the radius is $a_o/(mp+1)$.

The electric field of a hydrogen atom, or a deuterium atom, is zero for $r>r_n$ is the radius of the orbitsphere of the electron (see FIGURE 8.1). Thus, as the orbitsphere shrinks, approaching nuclei experience a smaller Coulombic barrier and the internuclear distance (between two deuterium atoms, for example) shrinks as well. As the internuclear separation decreases, fusion is more probable. In muon catalyzed fusion, for example, the internuclear separation is reduced by about 200 (the muon to electron mass ratio) and the fusion rate increased by about 80 orders of magnitude. In a catalytic system that produces energy holes of 27.21 eV, deuterium atoms can be repeatedly shrunk and the internuclear separation can be much smaller than the muon reduction. These smaller internuclear distances yield much higher fusion rates. We call this fusion process Coulombic Annihilation Fusion (CAF).

It is important to note that the products of CAF are tritium, ^3H, and protons, ^1H. In hot fusion, deuterium nuclei collide randomly and product about 50% ^3H plus ^1H and about 5O% ^3He plus a neutron. In CAF fusion, however, the nuclei are moving slowly and will collide in the most favored Coulombic arrangement -- with the two protons as far from each other as possible. These processes are shown schematically in FIGURE 8.2. See the Proton and Neutron Section for the equation of the orbitspheres of these nucleons.

Titanium(II) is one of the catalysts that can cause resonant shrinkage because the third ionization energy is 27.491 eV, m = 1 in equation (8.5). Thus, the shrinkage cascade for the path cycle is represented by:

$$27.491\ eV + Ti^{2+} + 2H[\tfrac{a_o}{p}] \rightarrow Ti^{3+} + e^- + 2H[\tfrac{a_o}{(p+1)}] + [(p+1)^2 - p^2] \times 13.6\ eV \qquad (8.7)$$

$$Ti^{3+} + e^- \rightarrow Ti^{2+} + 27.491\ eV \qquad (8.8)$$

And, the overall reaction is

$$2H[\tfrac{a_o}{p}] \rightarrow 2H[\tfrac{a_o}{(p+1)}] + [(p+1)^2 - p^2] \times 13.6\ eV \qquad (8.9)$$

Note that the energy given off as the atom shrinks is much greater than the energy lost to the energy hole. Furthermore, when fusion occurs even larger amounts of energy are liberated.

Rubidium(1) is also a potential catalyst. The second ionization energy is 27.28 eV.

$$27.28\ eV + Rb^+ + 2H[\tfrac{a_o}{p}] \rightarrow Rb^{2+} + e^1 + 2H\left[\tfrac{a_o}{(p+1)}\right] + \left[(p+1)^2 - p^2\right] \qquad (8.10)$$

$$Rb^{2+} + e^- \rightarrow + Rb^+ \rightarrow + 27.28\ eV \qquad (8.11)$$

The overall reaction is the same as equation (8.9).

Less efficient catalytic systems hinge on the coupling of three resonator cavities. For example, the third ionization energy of palladium is 32.93 eV. This energy hole is obviously too high for resonant absorption. However, Li(I) releases 5.392 eV when it is reduced to Li. The combination of Pd(II) to Pd(III) and Li(I) to Li, then, has net energy change of 27.54 eV.

$$27.54\ eV + Li^+ + Pd^{2+} + 2H[\tfrac{a_o}{p}] \rightarrow Li + Pd^{3+} + 2H[\tfrac{a_o}{(p+1)}] = [(p+1)^2 - p^2] \times 13.6\ eV \qquad (8.12)$$

$$Li + Pd^{3+} \rightarrow Li^+ + Pd^{2+}] + 27.54\ eV \qquad (8.13)$$

The overall reaction is the same as equation (8.9).

An efficient catalytic system that hinges on the coupling of three resonator cavities involves potassium. For example, the second ionization energy of potassium is 31.63 eV. This energy hole is obviously too high for resonant absorption. However, K(I) releases 4.34 eV when it is reduced to K. The combination of K(I) to K(II) and K(I) to K, then, as a net energy change of 27.28 eV.

$$27.54\ eV + K^+ + K^+ + 2H[\tfrac{a_o}{p}] \rightarrow K + K^{2+} + 2H[\tfrac{a_o}{(p+1)}] = [(p+1)^2 - p^2] \times 13.6\ eV \qquad (8.14)$$

$$K + K^{2+} \rightarrow K^+ + K^+] + 27.28\ eV \qquad (8.15)$$

The overall reaction is the same as equation (8.9).

Energy Holes

In general, absorption of an energy hole will cause the orbitsphere to undergo a transition from one stable non-radiative radius to another stable non-radiative radius. The coulombic force is attractive, thus, the orbitsphere will shrink when the effective nuclear charge increases. The orbitsphere has an initial radius, r_n, initial effective nuclear charge, Z_{eff}, and initial velocity, v_n, given by the condition for nonradiation

$$2\pi(nr_1) = n\lambda_1 \quad n = 1, 1/2, 1/3, 1/4, ... \qquad (8.16)$$

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$$v_n = \frac{n}{m_e n a_o} \tag{8.17}$$

At force balance,

$$\frac{n^2}{m_e (r_n)^3} = \frac{Z_{eff} e^2}{4\pi\varepsilon_o (r_n)_o^2} \tag{8.18}$$

[EDITORS NOTE: The above and below several equations have been re-numbered here for consistency to correct errors in the equation numbering in the Mills patent.]

Shrinkage occurs because the effective nuclear charge increases by an integer, m, when equations (8.16) - (8.18) are satisfied by the introduction of an energy sink of a coupled resonator, such as an electron orbitsphere resonator cavity comprising an electrochemical couple. The coupled resonator provides energy holes and affects the shrinkage transition from the initial radius $a_o/(mp+1)$ and a nuclear charge of (mp+1) to the second radius $a_o/[m(p+1) + 1]$ and a nuclear charge of m(p+1)+1. The potential energy diagram is given in FIGURE 8.3. Energy conservation and the boundary condition that trapped photons must be a solution to LaPlace's equation determine that the energy hole to cause a shrinkage is given by equation (8.5). As a result of coupling, the deuterium atom emits a photon of m x 27.21 eV, and this photon is absorbed by the coupled resonator. Stated another way, the deuterium atom absorbs an energy hole of m x 27.21 eV. The energy hole absorption causes a second photon to be trapped in the deuterium atom electron orbitsphere. Recall from the Excited States of the One Electron Atom Section that electromagnetic radiation of discrete energy can be trapped in a resonator cavity. As shown previously, the photonic equation must be a solution of LaPlace's equation in spherical coordinates. The photon field comprises an electric field which provides force balance and a nonradiative orbitsphere. The solution to this boundary value problem of the radial photon electric field is given by

$$\varepsilon_{l,photon\,j,l,m} = \frac{e}{4\pi\varepsilon_o} \frac{n a_o}{r^{l+2}} \left[-1 + n\left[Y_l^m(\phi,\theta) + Y_s^m \right] \right] \tag{8.19}$$

It is apparent from this equation that for l = 0 and given an initial radius of $a_o/(mp+1)$ and a final radius of $a_o/[m(p+1) + 1]$ that the nuclear charge is increased by m with the absorption of an energy hole of m x 27.2 eV. The potential energy decreases by this energy; thus, energy is conserved. However, the force balance equation is not initially satisfied as the effective nuclear charge increases by m. Further energy is emitted as force balance is achieved at the final radius. The relativistic part of the kinetic energy of the orbitsphere is equal to the energy of the photon which is trapped during absorption of the energy hole (See Proton and Neutron Section). By replacing the initial radius with the final radius, and by increasing the charge by m in Equations (8.18).

$$[m(p+1)+1]^3 \frac{n^2}{m_e a_o^3} = [m(p+1)+1]^2 \frac{(m(p+1)+1)e)e}{4\pi\varepsilon_o a_o^2} \tag{8.20}$$

force balance is achieved and the orbitsphere is nonradiative.

The energy balance for m = 1 is as follows. An initial energy of 27.21eV is emitted as the energy hole absorption event. This increases the effective nuclear charge by one and decreases the potential by 27.21 eV. More energy is emitted until the total energy released is $[(p + 1)^2 - p^2]$ x 13.6 eV.

In general, the resonance energy to cause shrinkage of the radius from a_o to $a_o/(m + 1)$ is m x 27.21eV, where m= 1,2,3,4. The resonant absorption of this energy hole causes the effective nuclear charge to increase by m. And, the energy released in going from infinity to $a_o/(m + 1)$ is (m + 1) x (m + 1) x 13.6 eV or $(m + 1)^2$ x 13.6 eV.

Energy holes add. The corresponding effective charges resulting from the absorption of energy holes also add. Thus, any combination of energy holes which sums to m x 27.21 eV where m is the same as the m for the final radius, $a_o/(m+l)$, leads to shrinkage to the same final radius of the orbitsphere.

Several examples of different energy holes affecting shrinkage and the corresponding effective nuclear charges, total energy released, and final radii of the orbitspheres going from infinity to the final radius, $a_o/(m + 1)$ are given in Table 8.1.

Energy released for any transition is given by ΔE_{final} (∞ to R) - $\Delta E_{initial}$ (∞ to R)

n	R	V(eV)	T(eV)	Zeff	Energy Hole Released (eV)	Total Released r =∞ to r=R
-	a_o	-27.2	13.6	1	-	13.6
1	$a_o/2$	-108.8	54.4	2	27.2	54.4
2	$a_o/3$	-244.9	122.4	3	54.4	122.4
3	$a_o/4$	-435.4	217.7	4	81.6	217.7
4	$a_o/5$	-680.2	340.1	5	108.8	340.1
5	$a_o/6$	-979.6	489.6	6	136.1	489.6
6	$a_o/7$	-1333.3	666.4	7	163.3	666.4
7	$a_o/8$	-1741.4	870.4	8	190.5	870.4
8	$a_o/9$	-2204.0	1101.6	9	217.7	1101.6
9	$a_o/10$	-2721.0	1360.5	10	244.g	1360.5

Energy Reactor

An energy reactor 50, in accordance with the invention is shown in FIGURE 1. and comprises a vessel 52 which contains an energy reaction mixture 54, a heat exchanger 60, and a steam generator 62. The heat exchanger 60 absorbs heat released by the said shrinkage reaction and fusion, when the reaction mixture, comprises of fusionable material, shrinks. The heat exchanger exchanges heat with the steam generator 62 which absorbs heat from the exchanger 60 and produces steam. The energy reactor 50 further comprises a turbine 70 which receives steam from the steam generator 62 and supplies mechanical power to a power generator 80 which converts the steam energy into electrical energy, which is received by a load 90 to produce work or for dissipation.

The energy reaction mixture 54 comprises an energy releasing material 56 including a source of hydrogen isotope atoms or a source of molecular hydrogen isotope, and a source of energy holes 58 which resonantly removes n/2 27.21 eV; where n is an integer, of energy, the resonance shrinkage energy, from hydrogen to effect shrinkage with a concomitant release of energy and shrunken atoms which can undergo fusion in the case where deuterium and/or tritium is used.

The source of hydrogen can be hydrogen gas, electrolysis of water, hydrogen from hydrides, or hydrogen from metal-hydrogen solutions. In all embodiments, the source of energy holes is one or more of an electrochemical, chemical, photochemical, thermal, free radical, sonic, or nuclear reactions, inelastic photon or particle scattering reactions. In the latter two cases, the present invention of an energy..reactor comprises a particle source 75b and/or photon source 75a to supply the said energy holes. In all reaction mixtures, a selected external energy device 75, such as an electrode may be used to supply an electrostatic potential or a current to decrease the activation energy of the resonant absorption of an energy hole. In another embodiment, the mixture 54, further comprises a surface or material to absorb atoms and/or molecules of the energy releasing material 56. Such surfaces or materials to absorb hydrogen, deuterium, or tritium comprise transition elements and inner transition elements including iron, platinum, palladium, zirconium, vanadium, nickel, titanium, Sc, Cr, Mn, Co, Cu, Zn, Y, Nb, Mo, Tc, Ru, Rh, Ag, Cd, La, Hf, Ta, W, Re, Os, Ir, Au, Hg, Ce, Pr, Nd, Pm, Sm, Eu, Gd, Tb, Oy, Ho, Er, Tm, Yb, Lu, Th, Pa, and U. In a preferred embodiment, a source of energy holes comprises a catalytic energy hole material 58, typically comprising electrochemical couples including the catalytic couples described in the Coulombic Annihilation Fusion Section of my previous U.S. patent application entitled "Energy/Matter Conversion Methods and Structures," filed on April 28, 1989, which is incorporated by reference.

Thus, an exemplary energy reaction mixture which provides energy from the shrinkage reaction and from fusion is molecular deuterium, a salt of Pd^{2+}, and a $lithium^+$ salt. Palladium absorbs molecular deuterium and the Pd^{2+}/Li^+ catalytic system effect resonant shrinkage of deuterium to the point of fusion. In one embodiment, the lithium is ^6Li in which case the neutrons released from fusion of deuterium effects the fusion of ^6Li to helium.

In other embodiments providing fusion, the fusionable material is one of any element of the periodic chart, and the energy of the holes of the said source of energy holes is resonant with the orbital shrinkage energy which is calculated using mechanics of the present invention and described for hydrogen in the Theory Section. In the preferred embodiment, ^2H, ^3H, or ^6Li is used as the fusionable material.

A further embodiment is the vessel 52 containing a molten, liquid, or solid solution of the catalytic couple(s) and a source of hydrogen including hydrides and gaseous hydrogen. In the latter case, the embodiment further comprises a means to dissociate the molecular hydrogen into atomic hydrogen including the transition or inner transition metals or electromagnetic radiation including UV light provided by photon source 75.

A preferred embodiment of the energy reactor of the present invention comprises an electrolytic cell forming the reaction vessel 52 of FIGURE 1 including a molten electrolytic cell. The electrolytic cell 100 is shown generally in FIGURE 2. An electric current is passed through the electrolytic solution 102 having an electrocatalytic couple providing energy holes equal to the resonance shrinkage energy (including the catalytic couples described in the Coulombic Annihilation Fusion Section of my previous U.S.Patent Application

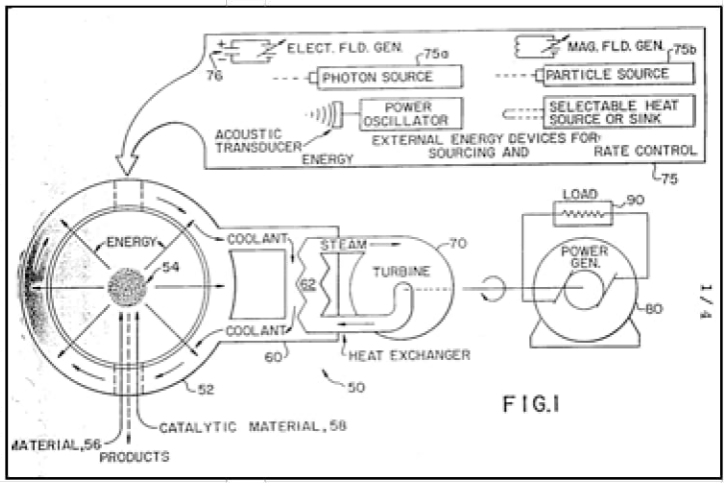

FIG.I

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entitled entitled "Energy/Matter Conversion Methods and Structures," filed on April 28, 1989 which is incorporated by reference) by the application of a voltage to an anode 104 and cathode 106 by the power controller 108 powered by the power supply 110. Ultrasonic or mechanical energy may also be imparted to the cathode 106 and electrolytic solution 102 by vibrating means 112. Heat is supplied to the electrolytic solution 102 by heater 114. The pressure of the electrolytic cell 100 is controlled by pressure regulator means 116.

In vacuum, in the absence of external fields, the energy hole to stimulate a hydrogen atom at rest to undergo a shrinkage transition is n/2 x 27.21 eV where n is an integer. This resonance shrinkage energy is altered when the atom is in a media different from vacuum. An example is a hydrogen atom absorbed to the cathode 106 present in the aqueous electrolytic solution 102 having an applied electric field and an intrinsic or applied magnetic field provided by external magnetic field generator 75. Under these conditions the energy hole required is slightly different from 27.21 eV. Thus, an electrocatalytic couple is selected which has a redox energy resonant with the energy hole which stimulates the hydrogen shrinkage transition when operating under these conditions. In the case where a nickel or graphite cathode 106 is used to electrolyze an aqueous solution 102 where the cell is operating within a voltage range of 1.5 to 5 volts, the K+/K+ and Rb+ couples are preferred embodiments.

The cathode provides hydrogen atoms, and the shrinkage reaction occurs at the surface of the cathode where hydrogen atoms and the electrocatalytic

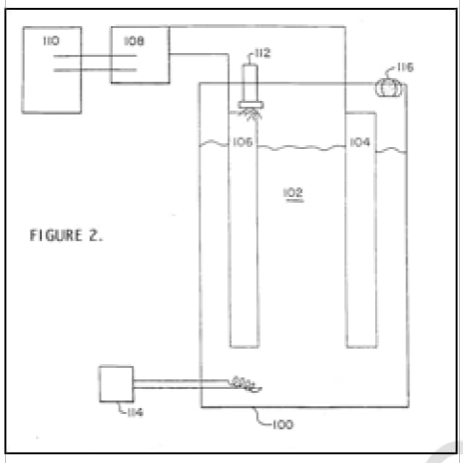

FIGURE 2.

couple are in contact. Thus, the shrinkage reaction is dependent on the surface area of the cathode. For a constant current density, giving a constant concentration of hydrogen atoms per unit area, an increase in surface area increases the reactants available to undergo the shrinkage reaction. Also, an increase in cathode surface area decreases the resistance of the electrolytic cell which improves the electrolysis efficiency.

Hydrogen atoms at the surface of the cathode 106 form hydrogen gas which can form bubbles on the surface of the cathode. These bubbles act as an insulation layer between the hydrogen atoms and the electrocatalytic couple. The insulation can be ameliorated by vibrating the cathode and/or the electrolytic solution 102 or by applying ultrasound with vibrating means 112; and by adding wetting agents to the electrolytic solution 102 to reduce the surface tension of the water and prevent bubble formation. The use of a cathode having a smooth surface or a wire cathode prevents gas adherence, and an intermittent current, provided by an on-off circuit of power controller 108, provides periodic replenishing of hydrogen atoms which are dissipated by hydrogen gas formation followed by diffusion into the solution while preventing excessive hydrogen gas formation which could form an insulation layer.

The shrinkage reaction is temperature dependent. Most chemical reactions double their rates for each 10°C rise of temperature. Increasing temperature increases the collision rate between the hydrogen atoms and the electrocatalytic couple which will increase the shrinkage reaction rate. With large temperature excursions from room temperature, the kinetic energy distribution of the reactants can be sufficiently altered to cause the energy effecting the hydrogen shrinkage transition and the electrocatalytic redox reaction to conform to a more or lesser extent. The rate is proportional to the extent of conformation or resonance of these energies. The temperature is adjusted to optimize the energy production rate. In the case of K+/K+ electrocatalytic couple, a preferred embodiment is to run the reaction at a temperature above room temperature by applying heat with heater 114.

The shrinkage reaction is dependent on the current density. An increase in current density is equivalent, in some aspects, to an increase in temperature. The collision rate increases and the energy of the reactants increases with current density. Thus, the rate can be increased by increasing collision rate of the reactants; however, the rate may be increased or decreased depending on the effect of the increased reactant energies on the conformation of the redox and shrinkage energy hole. Also, increased current dissipates more energy by ohmic heating and may cause bubble formation. But, a high flow of gas may dislodge bubbles which diminishes any hydrogen gas insulation layer. The current density is adjusted with power controller 108 to optimize the excess energy production. In a preferred embodiment the current density is in the range 5 to 400 milliamps per square centimeter.

The pH of the aqueous electrolytic solution 102 can affect the shrinkage reaction rate. In the case that the electrocatalytic couple is positively charged, an increase in the pH will reduce the concentration of hydronium at the negative cathode; thus, the concentration of the electrocatalytic couple cations will increase. An increase in reactant concentration increases the reaction rate. In the case of the K+/K+ or Rb+ couple, a preferred pH is basic.

The counterion of the electrocatalytic couple of the electrolytic solution 102 can affect the shrinkage reaction rate by altering the energy of the transition state. For example, the transition state complex of the K+/K+ electrocatalytic couple with the hydrogen a tom has a plus two charge and involves a three body collision which is unfavorable. A negative two charged oxyanion can bind the two potassiums; thus, it provides a neutral transition state complex of lower energy, whose formation depends on a binary collision which is greatly favored. The rate is dependent on the separation distance of the potassium ions as part of the complex with the oxyanion. The greater the separation distance, the less favorable is the transfer of an electron between them. A close juxtaposition of the potassium ions will increase the rate. The relationship of the reaction rate to the counterion in the case where the K+/K+ couple is used is:

$$OH^- < PO_4^{3-},\ HPO_4^{2-} < SO_4^{2-} << CO_3^{2-}.$$

Thus, a planar negative two charged oxyanion including carbonate with three binding sites for K+ which provides close juxtaposition of the K+ ions is preferred as the counterion of the K+/K+ electrocatalytic couple. The carbonate counterion is also a preferred counterion for the Rb+ couple.

A power controller 108 comprising an intermittent current, on-off, electrolysis circuit will increase the excess heat by providing optimization of the electric field as a function of time which provides maximum conformation of reactant energies, provides an optimal concentration of hydrogen atoms while minimizing ohmic and electrolysis power losses and insulation layer formation. The frequency, duty cycle, peak voltage, step waveform, peak current, and offset voltage can be adjusted to achieve the optimal shrinkage reaction rate and coulombic relaxation power while minimizing ohmic and electrolysis power losses. In the case where the K+/K+ electrocatalytic couple is used with carbonate as the counterion; nickel or graphite as the cathode; and platinum as the anode, a preferred embodiment is to use an intermittent square-wave having an offset voltage of approximately 2.5 volts to 2.2 volts; a peak voltage of approximately 3 volts to 2.75 volts; a peak current of approximately 175 mA; approximately a 40% duty cycle; and a frequency of approximately 720 Hz, although a range of between 300 Hz to 1500 Hz should perform satisfactorily. A preferred embodiment of the circuit of the power controller 108 is shown in FIGURE 3. The voltage waveform of this circuit is shown in FIGURE 4, and the current waveform of this circuit is shown in FIGURE 5.

The shrinkage reaction rate is dependent upon the composition of the cathode 106 and anode 104. Different anode materials have different overpotentials

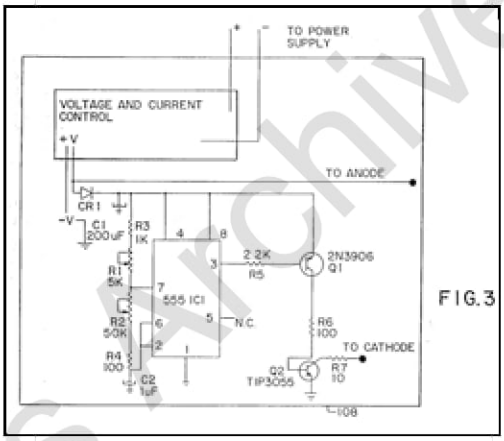

FIG.3

for the oxidation of water, which can affect ohmic losses. An anode of low overpotential will increase the efficiency. In the case of the K+K+ electrocatalytic couple where carbonate is used as the counterion, platinum and nickel are preferred anodes. Nickel is a preferred anode for use in basic solutions with a nickel cathode. Nickel is inexpensive relative to platinum and fresh nickel is electroplated onto the cathode during electrolysis. Hydrogen atoms are reactants to produce coulombic relaxation energy. Thus, the cathode must efficiently provide a high concentration of hydrogen atoms. The cathode 106 is comprised of any conductor or semiconductor including transition elements and compounds, actinide and lanthanide elements and compounds, and group IIIB and IVB elements and compounds. Transition metals dissociate hydrogen gas into atoms to a more or lesser extent depending on the metal. Nickel and titanium readily dissociate hydrogen molecules and are preferred embodiments. The cathode can alter the energy of the absorbed hydrogen atoms and affect the energy of the shrinkage reaction. A cathode material is selected which provides more favorable conformation of resonance between the electrocatalytic couple and the energy which effects the hydrogen shrinkage reaction. Also, coupling of resonator cavities and enhancement of the transfer of energy between them is increased when the media is a nonlinear media such as a magnetized ferromagnetic; thus, the cathode material can increase the reaction (coupling of the hydrogen and electrocatalytic couple resonator cavities) by providing a nonlinear magnetized media when a paramagnetic or ferromagnetic cathode is used or a magnetic field is applied with magnetic field generator 75. (Another nonlinear media is a magnetized plasma which comprises an embodiment with gaseous hydrogen atoms.) Magnetic fields of and/or at the cathode can alter the hydrogen electron orbital energy and concomitantly alter the energy which triggers shrinkage. And, magnetic fields can perturb the energy of electrocatalytic reactions where the energy levels of the electrons involved in the reactions are affected by the magnetic field of the cathode or a magnetic field at the cathode to which the hydrogen atoms are absorbed. A preferred ferromagnetic cathode is nickel. The cathode material is selected to optimize conformation of the energies and coupling. In the case of the K+/K+ couple with carbonate as the counterion, the relationship of the cathode material to the reaction rate is:

$$Pt < Pd << Ti < Ni, \text{ graphite (carbon)}$$

This is the opposite order of the energy released when these materials absorb hydrogen. Thus, for this couple, the reaction rate is increased by using a cath-

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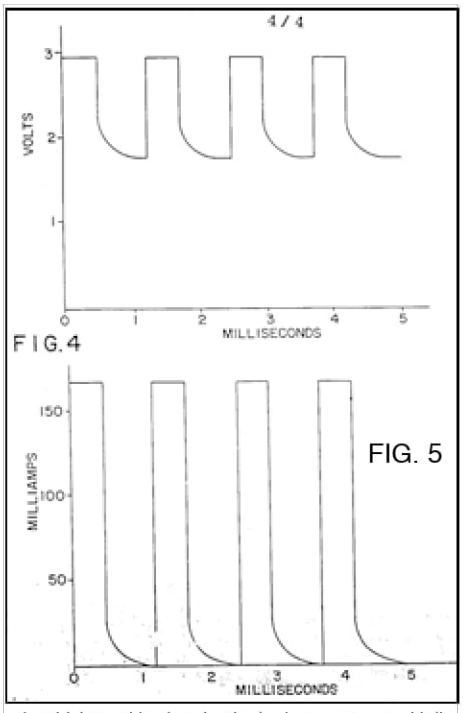

ode which weakly absorbs the hydrogen atoms with little perturbation of their electronic energies.

Further energy can be released by using deuterated or tritiated water as the aqueous electrolytic solution 102 which provide deuterium and tritium nuclei for fusion. The atoms which have undergone shrinkage diffuse into the cathode lattice where shrunken atoms collide and undergo fusion. The probability of a fusion event arising from a collision is increased for deuterium or tritium atoms of smaller dimensions arising from multiple shrinkage reactions. A cathode 106 is used which will facilitate multiple shrinkage reactions of hydrogen atoms. One embodiment is to use a cathode which is fissured and porous to the electrocatalytic couple such that it can contact shrunken atoms which have diffused into a lattice, including a metal lattice. A further embodiment is to use a cathode of alternating layers of a material which provides hydrogen atoms during electrolysis including a transition metal or graphite and an electrocatalytic couple such that shrunken hydrogen atoms periodically or repetitively diffuse into contact with the electrocatalytic couple.

The shrinkage reaction is dependent on the dielectric constant of the media. The dielectric constant of the media alters the electric field at the cathode and concomitantly alters the energy of the reactants. Solvents of different dielectric constants have different solvation energies, and the dielectric constant of the solvent can also lower the overpotential for electrolysis and improve electrolysis efficiency. A solvent, including water, is selected for the electrolytic solution 102 which optimizes conformation of the energies of the electrocatalytic redox reaction and that effecting the hydrogen shrinkage reaction and maximizes the efficiency of electrolysis.

The solubility of hydrogen in the reaction solution is directly proportional to the pressure of hydrogen above the solution increasing the pressure increases the concentration of hydrogen atoms (reactants) at the cathode and thereby increases the rate. But, this also favors the development of a hydrogen gas insulation layer. The hydrogen pressure is controlled by pressure regulator means 116 to optimize the reaction rate.

Experimental

With reference to FIGURE 2, an electrolytic cell energy reactor 100 was assembled comprising a dewar covered with a 0.75 inch fitted rubber stopper, a 5 cm long by 0.75 cm diameter graphite rode cathode 106, a 10 cm by 1 mm diameter spiraled platinum wire anode 104, a 0.57M [Ed. Note: M means "molar"] aqueous K_2CO_3 electrolyte solution 102, a heater 116 comprising a 100 ohm 1% resistor in a teflon tubing powered at constant voltage of 14.8 volts, a constant voltage power supply 110, and the power controller 108 having the circuit shown in FIGURE 3. The current voltage parameters were an intermittent square-wave having an offset voltage of approximately 2.2 volts; a peak voltage of approximately 2.75 volts; a peak current of approximately 175 mA; approximately a 40% duty cycle; and a frequency of approximately 720 Hz. The voltage and current waveforms are shown in FIGURES 4 and 5, respectively. This energy reactor, typically yielded 7.5 times times the heat power output as the electrolysis heat power input as determined by calibration of the dewar vessel during operation using the differential calorimetry method.

When the graphite cathode was replaced by a 7.5 cm wide by 5 cm long by 0.125 mm thick nickel foil spiral of 9 mm diameter and 0.5 mm pitch and the other conditions and the apparatus were kept constant, the yield ratio of output over input was typically 7.5. When the cathode comprising a 7.5 cm wide by 5 cm long by 0.125 mm thick nickel foil cathode and the other conditions and the apparatus were kept constant, the yield ratio of output over input was typically 5.5. The yield ratio of output over input was typically 3.5 when the heater was off. When the 0.57M aqueous K_2CO_3 electrolyte solution 102 was replaced by Na_2C0_3, the yield ratio of output over input was typically 1.0.

An electrolytic cell energy reactor 100 was assembled comprising a 200 ml tall form beaker covered with parafilm, a 5 cm long by 2 cm wide by 0.125 mm thick nickel foil cathode 106, an anode 10 comprising a 25 cm long 32 gauge platinum wire spiraled about a 2 mm outer diameter glass capillary, a 0.57M aqueous K_2CO_3 electrolyte solution 102, and a constant voltage supplied by power supply 110. The current voltage parameters were a continuous voltage of approximately 4 volts and a current of approximately 300 mA. This energy reactor typically yielded 1.8 times the heat power output as the electrolysis heat power input as determined by calibration of the dewar vessel during operation using the differential calorimetry method. When the polarity was reversed making the Pt wire the anode, the yield ratio of output over input was typically 1.1 When the 0.57M aqueous K_2CO_3 electrolyte solution 102 was replaced by KOH, the yield ratio of output over input was typically 1.1. When the 0.57M aqueous K_2CO_3 electrolyte solution 102 was replaced by K_2SO_4 or K_2HP0_4, the yield ratio of output over input was typically 1.3. When the 0.57M aqueous K_2CO_3 electrolyte solution 102 was replaced by Na_2CO_3, the yield ratio of output over input was typically 1.0.

The claims defining the invention are as follows:

1. A method of extracting energy from hydrogen comprising the steps of: contacting a transition catalyst with hydrogen under conditions whereby said hydrogen undergoes a transition to an energy state lower than n=1 and energy is released from said hydrogen, wherein n is the energy state of an electron in a hydrogen atom and said transition catalyst is a catalyst for catalyzing the transition of hydrogen to an energy state lower than n=1.

2. The method of claim 1, wherein said transition catalyst includes an electrochemical reactant comprising at least one of a cation and an anion.

3. The method of claim 1, wherein said transition catalyst has an ionization energy substantially equal to said transition energy.

4. An apparatus for providing the release of energy, comprising:
a vessel capable of containing fluids;
a source of hydrogen atoms;
an effective amount of a transition catalyst for catalyzing the transition of a hydrogen atom to an energy state lower than n=1, wherein n is the energy state of an electron in said hydrogen atom; and means for contacting said transition catalyst with said hydrogen in said vessel under conditions whereby said hydrogen atom undergoes a transition to an energy state lower than n=1 and releases energy.

5. The apparatus of claim 4, wherein said transition catalyst has an ionization energy substantially equal to said transition energy.

6. The apparatus of claim 4, wherein said transition catalyst includes an electrochemical reactant comprising at least one of a cation and an anion.

7. The apparatus of claim 5, wherein said transition catalyst comprises K+ coupled with K+.
[Editor's Note: No claims #8 through #12 were printed in the patent as received.]

13. The apparatus of claim 8, wherein said electrolytic cell is operated at a temperature above room temperature.

14. An apparatus of claim 4, wherein: said transition catalyst is a single cation, neutral atom, or anion or a single molecule which is a cation, neutral molecule or anion, or is a combination of said species wherein said transition catalyst catalyzes transitions with energies substantially equivalent to (n/2) x 27.21 eV where n is an integer.

15. The apparatus of claim 4, further including a pressurized gas energy reactor comprising: a second vessel containing a source of molecular hydrogen; a means to dissociate the molecular hydrogen into atomic hydrogen; an effective amount of said transition catalyst; and a power supply providing a current.

16. The apparatus of claim 15, further comprising a heating means to control the rate of said transition.

17. A method of extracting energy from hydrogen, substantially as hereinbefore described with reference to any one of the Examples.

18. An apparatus for providing the release of energy, said apparatus substantially as hereinbefore described with reference to any one of the Examples.

19. An apparatus for providing the release of energy, said apparatus substantially as hereinbefore described with reference to the accompanying drawings.

Dated 19 March, 1996
Randell Lee Mills
Patent Attorneys for the Applicant/Nominated Person
SPRUSON & FERGUSON

INTERNATIONAL SEARCH REPORT
International Applications No. PC/US91/08496

Classification of Subject Matter:
According to international Patent Classification (IPC) or to both National Classification and IPC
IPC(5): G2IB 1/00 U.S. CL: 376/100

Fields Searched: US Classification System:

376/100, 146, 114, 115, 204/129, 242, 292

Documents considered to be relevant:

US, A, 4,986,887 (GUPTA ET AL. 22 JANUARY 1991), relevant to claim 4-15

US, A, 1,737, 249 (SHEPARD, JR. ET AL.12 APRIL 1988) (Abstract), relevant to claim 4-15

US, A, 1,001,589 (HATFIELD) 23 AUGUST 1911 Abstract, Figure 3, relevant to Claim No. 4-15

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Editor's Note:

On a sheet attached to the patent, a section is checked:

"Observations where certain claims were found unsearchable."

The text continues:

"This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons —Claim numbers 1-4 because they relate to subject matter not required to be searched by this Authority, namely: The material is excluded by Rule 39."

An explanation of Rule 39 is appended:

"OBSERVATIONS REGARDING UNSEARCHABLE CLAIMS:

Rule 39 of the Patent Cooperation Treaty, which applies to subject matter under Article 17(2)(a)(i), states "No international Searching Authority shall be required to search an international application if and to the extent to which, its subject matter is any of the following: (i) scientific and mathematical theories ....

The Examiner contends that the basis of the Applicant's invention rests on an unfounded theory, which to date has absolutely no supporting evidence except Applicant's disclosure. Furthermore, if such a theory were correct the world of quantum mechanics would be essentially revolutionized overnight. To the extent that this has not occurred, the Examiner considers the basis of Applicant's invention to be unfounded and unsearchable in the context of Rule 39."

Mills' patent suggests ultrasonic formation of hydrinos, among other methods. May I suggest to Dr. Mills that he become more familiar with the large body of very solid nuclear results within the "cold fusion" field—results that he can surely learn from and profit by. It would be splendid if we could see him at one of the forthcoming conferences, such as in Vancouver at ICCF-7.

One final point: No matter how others—such as Mills and CETI— may try to distance themselves from he term "cold fusion," it remains a historical fact that both CETI and Mills were triggered in their thinking about excess heat by the Fleischmann and pons announcement—just look at the filing dates of these various patents. So, it would be nice if we could all learn to live together under the same tent! ***—Gene Mallove***

Dr. Randell Mills, Hydrinos, and Cold Fusion: A Comment

by Eugene Mallove

As I wrote earlier, we are extremely grateful to have the interview with Dr. Mills in this issue of *Infinite Energy*. We featured more news about him and BlackLight Power, Inc. in issues #12 and Issues #13&14. You will also find a wealth of material about Mills and his company on his WWW site—designated here. You can also order from his company his very thick treatise (533 pages in its 1995 edition), ***The Grand Unified Theory of Quantum Mechanics***.

We take strong exception, however, to Dr. Mills conclusion that other cold fusion companies have only minimal performance devices—that is simply not true. The Patterson cell of CETI has exhibited strong multiples of excess power over input—from multiples of several 10s to 100s and even 1,000. Also, Dr. Mills should be aware that Motorola really did test a Patterson cell and found that it produced continuing 20 watts of thermal output with *zero* input power for at least 11 hours, declining over *days* — once it started. How *similar* this is to the much higher temperature gas-phase process of BlackLight Power, which works, in theory, with no electric power input—as long as hydrogen is provided! In practice, a small amount of the generated electric power would be used to keep the atomic hydrogen-producing filament glowing.

The test that Jed Rothwell performed on a CETI cell at PowerGen at Anaheim in 1995 is as solid as a rock. It was not "milliwatts" input, but 1.4 watts input, with over 1,300 thermal watts out. This was measured by the most elementary and convincing calorimetry. CETI has improved its bead production techniques and is learning more about bead heat-producing reliability. A word to the wise: just as it is likely that much more progress has been made at BlackLight than even Dr. Mills has revealed, the same may be true of other excess energy companies—whatever their theories of how these processes work.

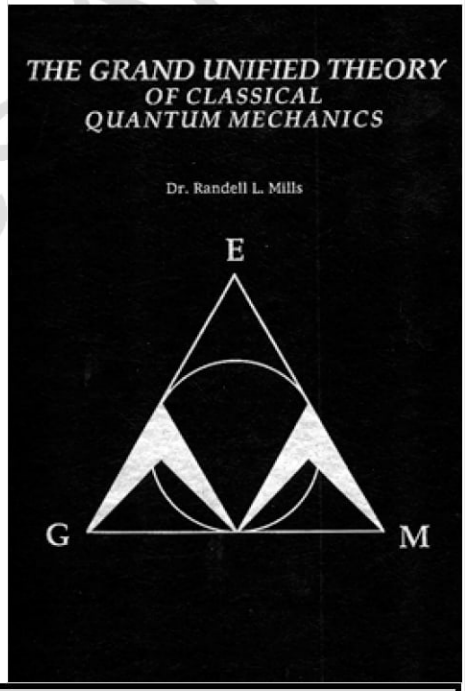
It is my conviction that the transmutation phenomenon that has been so resoundingly now proved within the "cold fusion" field, must now find a place within Dr. Mills thinking. It would seem a simple extension of the ideas expressed in his Australian patent. The neutral-like hydrinos could be the mechanism by which highly positively-charge nuclei are invaded and disrupted.

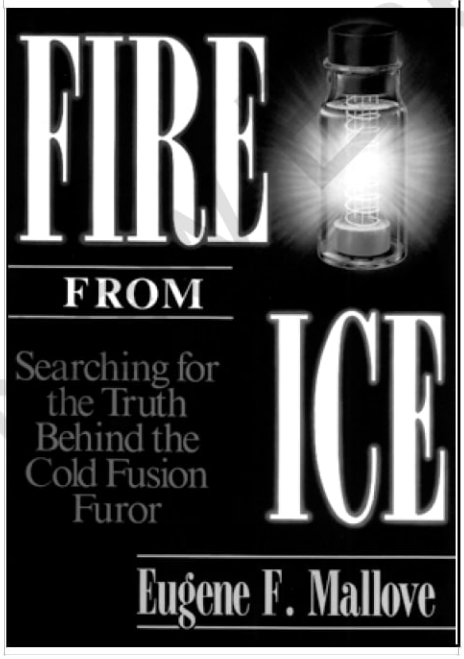
Since I also hold the firm opinion that cavitation excess energy devices, such as the HydroSonic™ Pump of James Griggs are real, could it also be that hydrino-formation, heat production, and even transmutation occurs ultrasonically in the Griggs device? Dr.

← Continues to the left

Ordering information for Dr. Randell L. Mill's book, *The Grand Unified Theory of Classical Quantum Mechanics,* may be found at:

http://www.blacklightpower.com *or* write to BlackLight Power Corp. Great Valley Corporate Center 41 Great Valley Parkway Malvern, PA 19355





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By Eugene F. Mallove, Sc.D.
Published by John Wiley & Sons, Inc., 1991, 334 pp.

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Metallographic & Excess Energy Density Studies of LGEN™ Cathodes Subject to a PAGD Regime in Vacuum

Dr. Paulo N. Correa
Alexandra N. Correa

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INTRODUCTION

Supplementing the material detailed in Labofex's Scientific Reports S1-002, S1-006, and the PCT/CA93/00311 Application regarding the design of PAGD generators (LGEN™ reactors), this Scientific Report addresses the PAGD current densities at the electrodes, in the cathode PAGD plasma ball and at the emission foci. Determination of the latter two parameters required both videographic and metallographic analyses, performed utilizing diverse types of cathode metals. PAGD cathode affinity was found to correlate with the electronegativity and work-function of the metal employed, PAGD affinity increasing with decreasing work-function. Anode surface distortions were equally examined. Utilizing this data together with determinations of the pulse input energy and the energy associated with the anomalous cathode reaction forces (proportional to 10^3 to 10^4 i^2) observed in the LGEN™ reactors during operation in the PAGD regime, we ascertained the fuel (cathode metal) consumption per PAGD, as well as the energy density of the fuel employed and expected cathode lifetimes.

On the basis of the results herein presented, the PAGD regime can be regarded to be an autogenous pulsatory plasma discharge regime characterized by the presence of quasi-periodic, self-generating and self-extinguishing autoelectronic cold cathode emissions that segment an abnormal plasma glow, and do so at low values of the breakdown field and at variance with the Fowler-Nordheim field-emission theory (that governs the VAD regime) with respect to the observed PAGD (low) emission current densities. Lastly, the PAGD regime deploys large anomalous reaction forces comparable to the reaction forces that have been described for water-plasma arcs, and 100x greater than those observed in VADs.

1. AVERAGE ELECTRODE CURRENT DENSITIES

Following Example 5 and Table 6 of the PCT/CA93/00311 Application (**1**), the current densities (Table 1, columns I and M) for the overall electrode areas employed were determined experimentally and compared to the values predicted on the basis of the glow discharge theory (Table 1, columns H and L), under the same conditions and with the same devices as described for the referred Example 5. Accordingly, columns A to G are identical in Table 1 of this Report and in Table 6 of the PCT/CA93/00311 Application. As explained beforehand in Example 5 of this Application (**1**), given a linear factor k_L between two vacuum tubes "a" and "b", they will have the same breakdown voltage if the pressure of "b" decreases by $1/k_L$, with the result that J (the average electrode current density) should decrease by $1/k_L^2$ while J/p^2 should remain constant (if the pressure varies) (**2**). Predicted and experimentally determined J/p^2 values are shown in columns J and K of Table 1. Essentially, as the area factor between the two pulse generators is $k_A = k_L^2$, both the charge density r and the current density J should change by $1/k_L^2 = 1/k_A$, ie. inversely to the plate area factor k_A. This is indeed what is observed at breakdown (Vb), for invariant pressure group #'s 5 and 6, columns H to K, Table 1. The same relation however does not apply as a function of the maximum input power and lowest sustaining or extinction voltages (columns L to O, Table 1), respectively, 676 and 368 V, as the plate current density and J/p^2 values of the same group #'s 5 and 6 are virtually identical, despite the invariant pressure and the $k_A = k_L^2$ area factor between the two pulse generators.

Examples of typical average electrode current densities encountered in the PAGD regime are shown in Table 2 for different area aluminum plates, as a function of the input current. Electrode J values vary from 10^{-2} A/m^2 to 10^3 A/m^2.

2. EMISSION STRUCTURE, AREA AND CURRENT DENSITIES.

Determination of the videographed equatorial diameter of the core of the cathode plasma ball at the base of each PAGD channel (see Fig.s 1 and 2) allowed us to approximate grossly the emission area per pulse and the pulse current density at the emitter surface, utilizing a reactor built with H34 aluminum plates (tube #1, Table 1 of the cited PCT application (**1**)). Measurements were taken at the equator from the extreme infra-red light component alone of the pulsed abnormal glow discharges at fully closed aperture (Fig. 2).

At PAGD breakdown voltages (Vb) of 1100 to 1350, the mean equatorial area of the cathode plasma globule was 2.8±0.03 mm^2. At PAGD plateau breakdown (Vb) voltages of 700 to 850 volts, the mean equatorial area of the cathode PAGD plasma globules were 3.8 and 0.95mm^2 with anode and cathode voltages respectively (#'s 4 and 2, Table 3). As indicated by the input current progression of group #'s 2 to 5, the mean equatorial area of the cathode plasma globule increases with increasing input current (cf columns B and C, Table 3). Group #6, Table 3 shows similar results for an Alzak cathode. This videographic determination of the mean equatorial area of the cathode plasma globule allowed an estimation of the overall emission, and thus the calculation of (uncorrected) emission current densities (J_{em}), shown in column D, Table 3.

Autographic analysis of the PAGD-induced cathode craters in Alzak plates was performed next, and their aspect, average inner diameter and maximal depth were determined (device #2, Table 1 of the cited PCT application (**1**)) after 30 seconds of operation at 500 PPS. Only isolated craters were measured, following the autograph method of Daalder (**3**). The PAGD operation at levels where Vb and Vx were very close, showed a discharge that, despite the smoothness of the surface, tended to move over most of the cathode, with the highest concentration of emission craters found at the lateral edges. The Alzak surfaces particularly lend themselves to this type of analysis because of their homogeneous aspect: before PAGD operation, the 'broken in' surface appears smooth except for very small holes (~1 to 7 μm diameter) and the 'break in' lines that appear where the Alzak was sheared during 'pulling' in at manufacture (see Fig. 3). After PAGD operation, two types and sizes of craters could be observed (see Fig.s 4&5):

1) the large type, or primary craters, which had an average inner diameter of 0.28 ± 0.03 mm and a mean area of 0.000615 ± SE $7*10^{-5}$ cm^2 (Fig. 4), see group # 9, Table 3;

2) smaller pits, typically distributed radially around a major crater or a cluster of these (see Fig.s 4, 5&6), and which have a mean diameter of 5.5 μm.

The crater complexes often occur in discrete clusters (Fig. 7) of 2 to >10, defining surface neighborhood regions of PAGD emission where the discharge repetitively struck. The inner or bottom circular area of the primary craters characteristically shows a twirl or swirling pattern of molten metal along one

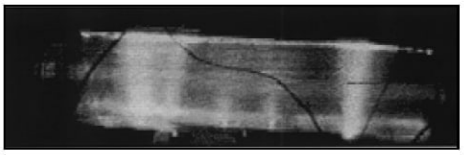

Fig. 1- Single video frame (31.25 msec) of 5 diachronic PAGD channels, each channel or vortex being anchored by a plasma ball at the cathode (bottom plate). LGEN™ reactor characteristics: H34 Al 128cm^2 area plate electrodes; 5 cm gap; Vb=700V; Vx=480V; DCA=0.24A; ppACArms=0.6A; sealed vacuum of 10^{-6} Torr; 130 PPS.

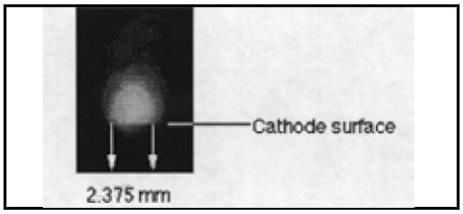

Fig. 2- Cathode plasma ball over the PAGD emission site in a LGEN™ reactor with Alzak plate electrodes (IR filter on). The plasma globule has a core diameter of 0.24 cm and an estimated area of 0.044 cm^2. The current density at the ball's largest cross-section is $1.25*10^5$ A/m^2. Reactor characteristics: 128cm^2 area plate electrodes; 5 cm gap; Vb=680V; ppACArms=0.55A; sealed vacuum of 10^{-6} Torr; 30 PPS.

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of its diameters with solidified metal droplets scattered about (see Fig. 8). Gross macroscopic examination of these craters exhibits a whitish periphery suggestive of aluminum oxide deposits. The secondary craters appear to have resulted from the sputter of the primary emission site and are often found at the end of, or the intersection with, fine (0.5 to 1μm wide) fissure lines similar to the 'break in' lines, but distributed radially from the primary crater where they originate (see Figs. 4&5); in turn, these secondary craters give way to a finer radial sputtering of their own (see Figs 5 and 6).

A comparison of the emission area values obtained by the autographic method of crater size determination and the videographic method of measuring the equatorial cathode ball diameter, indicates a substantial divergence between them, and the resultant estimation of the current density at the primary emission site. The reason for the discrepancy between the two methods arises directly from the emission structure encountered micrographically: even though measurements of the luminous emission globules did not include the zones of less intense luminosity (the fringe, see Fig. 1), metallographic examination had shown that each focus of emission had a multiplicity of minor emission craters associated with it; these secondary craters were dispersed in a radius of three to four primary crater diameters from the primary crater's center, and they thereby increased the total area involved in associated emission to an average of 0.037 cm^2. This corresponds rather well to the obtained videographic value of an area of 0.044 cm^2 for the cathode plasma globules in Alzak plates, (group # 6, Table 3) as measured on the cathode that was later disassembled for autographic analysis. Typically, the videographic method overestimates the area of primary emission site by 62 to 88x. The two methods thus identify distinct structures of the emission process: whereas the metallographic method identifies primary and secondary emission sites separately, the videographic method identifies the overall area of the emission complex which includes the secondary craters associated with the primary emission site. Due to these findings, and based upon the metallographic measurements, a general correction factor of 75x was applied to approximate the PAGD emission areas and current densities at the primary emission site *measured videographically*, as shown in group #'s 1 to 6, columns F to H, Table 3. These values correspond *well* with the values obtained, for the same type of plate material, by the metallographic method (eg cp group # 6 with group # 9), to the advantage of the videographic method which does not require disassembly of the reactor. With this approach, PAGD primary emission site current densities as low as 1-2.5*10^5 have been measured.

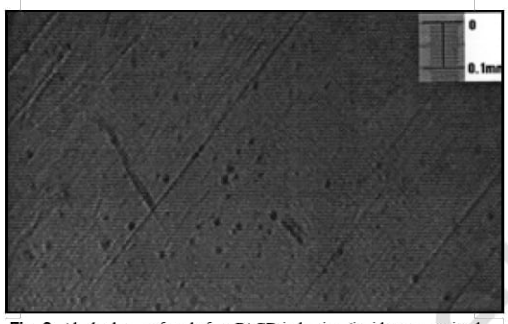

Fig. 3- Alzak plate surface before PAGD induction (incident transmitted light). Note the absence of crater formation or impact splatter.

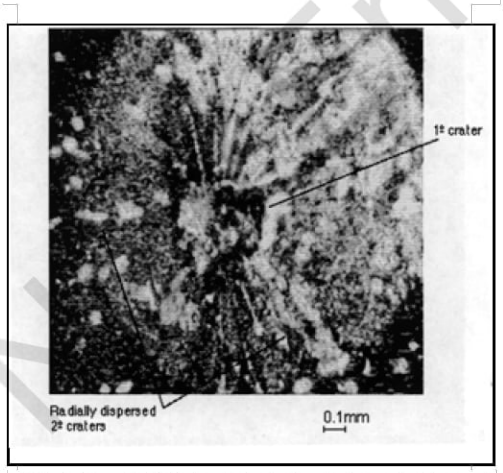

Fig. 4- Primary type of Alzak cathode PAGD emission crater and associated secondary pit-type craters typically found along surface crack lines radially distributed around the primary crater. Metallographic examination is performed best with a combination of incident (transmitted) and oblique light. The cathode plasma ball sits over the area of the entire complex.

Autographic analysis of the PAGD-induced cathode craters in H34 plates was equally performed, and their average inner diameter and maximal depth were determined, examples of which are given in group #'s 7 and 8, Table 3. An illustration of such a crater typically formed in isolation by high input current (~0.4ADC) PAGDs, is also shown, at low and high magnification, in Fig. 9. The secondary craters characteristically found in Alzak plates, along fracture lines irradiating from the main crater, are absent in H34 plates; instead, in H34 plates, one observes a roughened surface surrounding each crater, quite distinct from the original rough aspect of the pulled finish of these hardened aluminum plates, as if the surface surrounding the emission crater was boiled off. Like the Alzak-PAGD primary craters, the aspect of the H34-PAGD emission craters is a concave one, having raised circular borders (the lip), somewhat like a volcano. This topology may be easily seen in differential interference contrast emulations shown in the micrographs of Figs. 10 and 11. Often, at the bottom of the concavity, the H34 craters have a convex, cooled molten metal droplet. Eventually, as the pitting resulting from PAGD cathodic emissions covers the entire cathode, the cathode surface gains a very different aspect from the original one (Fig. 12), as it becomes finely pitted with interspersed protuberances. In this process, craters from earlier metal layers become progressively covered and eroded by subsequent emissions from the same cathode, as shown in Fig. 13.

These PAGD crater signatures are akin to Rakhovsky Type I VAD cathode spots (**4**), of discontinuous manifestation and far from steady state, except they occur at very low fields and with low emission current densities (see below). However, itinerant track signatures akin to those described by Rakhovsky for Type II VAD cathode spots may also be observed at high PAGD frequencies of autoelectronic emission, be this high-frequency due to high input currents and their clustering of multiple emissions and plasma re-ignitions around a single event (see Fig. 14), or be it due to fast, periodic autoelectronic emissions and plasma re-ignitions evenly spaced apart in time and at lower input currents (see Fig. 15), *on highly polished cold cathode surfaces*. It is probable that the PAGD cathode crater formation observed is a low PAGD frequency and moderate input current phenomenon. In highly polished aluminum surfaces, this PAGD cathode ejection phenomenon is accompanied by formation of radial, zig-zagging crack lines where other secondary emission sites originate. In hardened aluminum cathode surfaces that have a smooth finish, the PAGD emission sites splay out from a central zone in patterns reminescent of Mandelbrot's fractals, branching out along the crack lines. This is clearly seen in Figs. 16 and 17, where the starry emission sites are very shallow and do not present a crater, the central zone of the emission being characterized by the concentration of spikes and cooled metal droplets. Similar fractal patterns are observed in highly polished aluminum surfaces, such as Alzak, not as the result of a single emission site, but, as shown in Fig. 14, as the result of successive emission sites, as if the PAGD emission foci were burrowing a furrow on the surface of the cathode. Possibly, at higher input currents or high rates of PAGD auto-electronic emission, one or more of the crack lines joining the secondary sites becomes a track for successive primary emission foci (volcanic action model), with the result that the discharge preferentially migrates along one of these fissure lines, which it keeps on repeatedly creating as it moves forward, to produce furrows of itinerant emission. Like the path of a micro-cyclone, the resulting track has a sinusoidal appearance. Together with the spiraloid imprint at the emission crater (the helicoidal lip and the helicoidal burrowing of the crater core), this suggests that there is a net spin associated with the plasma vortex at the cathode, and thus that the cathode plasma ball exhibits gyration. It also suggests that the underlying spin field is transmitted across the separate and successive emission events and respective cathode plasma balls, to form the spiraling track signatures.

Altogether different is the surface deposition process occurring at the anode; here, the surface appears to become more uniform, through the mirroring and possibly abrasive actions of the cathode jets. Macroscopically, with time of PAGD operation, the anode surface appears cleaner and polished. However, with the most intense PAGD discharges, one can observe the formation of diverse size (from ~25 to 500μm widest diameter) molten metal bubbles, often with a smeared aspect (splatter type), ringed all the way around by a concave or inverse lip, like a moat, on the anode surface of both H34 and Alzak electrodes (see Fig.s 18 and 19). As shown in the diagram of Fig. 20, these anode signatures are the inverse or negative form of the cathode craters observed under the same conditions of PAGD operation. This is seen to further corroborate the cathode emission mechanism discussed (ejection of metal ions) and the collection of the plasma metal ions, by impact, at the anode.

With the data obtained by the metallographic method of crater measurement, we estimated the volume of metal ejected from a H34 Al cathode, by assuming that the crater represents a concavity analogous to a spherical segment having a single base (1/6π*H

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$[3r^2+H^2]$, where H is the height of the spherical segment and r the radius of the sphere), while disregarding the volume of the occasional central droplet leftover from the emission. The following are mean ±SEM crater diameters (D), crater depths (H) and volumes (V) of extruded metallic material for two types of aluminum cathodes, Alzak and H34 hardened aluminum, subject to a high input current PAGD:

1- Alzak: D-0.028cm±0.003; H-0.002cm±0.0002; V- $6.2*10^{-7}cm^3$;
2- H34: D-0.0115cm±0.0004; H-0.0006±0.0001; V- $3.1*10^{-8}cm^3$;

This data indicates that, on the basis of the input currents, the PAGD reactors do not reach the critical value of $\sim 7*10^8$ A/m^2, ie the threshold required by the Fowler-Nordheim theory for field emission. How is emission occurring at low applied fields and low emission current densities? Based on measurements of the peak pulse current developed by the reactor, there is an anomalous reaction current set up within the reactor. This is exemplified in Fig. 18 B of the PCT/CA93/00311 Application **(1)**. These anomalous reaction currents may be as low as 100 mA but, typically of interest, are of the order of 0.5 to >200 A. On the basis of this anomalous reaction current phenomenon, primary emission current densities of the order of 10^7 to 10^9 A/m^2 can be estimated.

3. LOW FIELD EMISSION

Unlike prior art planar or coaxial electrode discharge devices **(5-8)**, which utilizes short gap and high field discharges (typically >100,000 V/m) in the absence of an unexploited electrode area effect, the PAGD reactors are essentially low breakdown field devices with long gaps, and which advantageously employ the area effect to reduce the field strength, as described previously for Fig. 11 of the PCT/CA93/00311 Application **(1)**. Typical examples of the values of the PAGD breakdown fields at various negative pressures, for aluminum and nickel cathodes of reactors that were sealed (at diffusion pump vacua) or pumped down (by rotary pump action), are shown in Table 4. The breakdown field values mostly range from 5,000 to ~30,000 V/m. Similar ranges were shown in Fig. 11 of the PCT/CA93/00311 Application, where PAGD breakdown fields can be seen to vary from a minimum of 2,730-5,090 V/m to a maximum of 15,640 V/m. (Extinction field values may be as low as 1,000 to 2,000 V/m.) As extensively discussed in the referred to PCT application, the breakdown field value is modulated by the voltage reduction area effect, the interelectrode gap distance and the residual gas pressure in the gap. Generally, increasing the gap distance increases the required field strength. The voltage reduction effect of large area electrodes appears to be mainly responsible for the low field breakdown characteristics of the self-generating auto-electronic emissions encountered in the PAGD regime. Field-emission theory typically requires a very high breakdown field value, greater than $2*10^9$ V/m, for auto-electronic emission (eg in a VAD). If we disregard momentarily the fact that the PAGD has a positive I/V^2 slope and take its cathode- or anode-supplied voltage intercepts in a Fowler-Nordheim plot (0.0005 and 0.00005, respectively) to calculate the field-enhancement factor β required by the field-emission theory to explain the unpredicted auto-electronic emissions observed in the PAGD regime , we end up with β values of the order of 10^6 to 10^7 (for actual fields of 15,000 V/m), if we are to assume (which we should not) that the long gap PAGD operates like a (short-gap) VAD. Indeed, what is remarkable about the PAGD regime in these reactors is the very low (>10^5-fold lower) values of the fields required for the PAGD transduction of high current densities, a phenomenon that actually occurs in known VAD regimes (cold cathode or thermionic), but typically at 10^2-fold lower values than those required and predicted by the field-emission theory **(9)**.

4. PULSE INPUT ENERGY.

Pulse input energy was determined for a variety of conditions (pressure, gap, electrode area, residual gas, input current and input voltage, duration of input pulse, cathode material, etc) and typical examples are presented in Table 5. In the PAGD regime, input pulse duration and corresponding duty cycle are self-regulated events dependent upon the frequency controlling factors discussed in the PCT/CA93/00311 Application **(1)**, and thus the input pulse times shown in Table 5 are spontaneous and not externally determined, eg as for interrupted vacuum-arc discharges (IVADs). As a function of the input power characteristics, input energy per pulse in the PAGD regime ranged from as low as 1 mJ to >112J (Table 5). Values as high as 250J/PAGD input energy have been determined without slippage to a VAD regime for typical 5-8 cm gap, 4 to 128 cm^2 plate reactors. Under the same conditions, higher values will promote slippage of the PAGD into the VAD regime. However, higher values are possible with still longer gap reactors and higher input currents (eg 4 to 10 A).

5. REACTOR PULSE ENERGY.

Typical input, reactor and output energies per pulse, respectively, columns A to C, ordered vertically by increasing input energy, are shown in Table 6. The data was obtained with plate reactors of 4 to 128 cm^2 cathode areas, gaps of 5 to 8 cm, at different pressures (in air or argon) and PPS rates of 0.1 to 110 (column D, Table 6). Two separate types of associated circuits were utilized to measure the output energy per pulse (column C, Table 6):

1) In a double diode configuration, oscillographic reactor measurements for groups # 1 to 3, Table 6, were taken at the junctions of the cathodes with capacitors 10a and 10b (Fig. 21A of the PCT/CA93/00311 Application **(1)**), and at the junction of the axial anode with another capacitor placed prior to the centertap of transformer 26, in series with both parallel capacitors 10a and 10b. Coils 26a and 26b of transformer 26 were replaced by a third series capacitor intermediate parallel capacitors 10a and 10b, and oscillographic AC output readings taken across this capacitor (groups # 1 to 3, Table 6); the total series capacitance was 5.3 μF.

2) In a single diode configuration, oscillographic reactor measurements for groups # 4 to 14, Table 6, were taken at the junctions of the cathode with capacitor C3, and of the anode with capacitor C5 (Figs 23 and 38 of the Energy Conversion System PCT/CA93/00430 Application **(10)**), and oscillographic or long-term DC output readings were determined at the input to the battery pack CP (Figs. 23 and 38 of the Energy Conversion System PCT Application **(10)**); the C3/C5 series capacitance was 17.5mF.

Two conclusions, independently from all other varying conditions, may be taken from Table 6 data: the pulse energy released within the reactor varies from <3 to >50x the input energy per pulse (column A vs columns B and C); and, in general, the reactor energy varies inversely to the pulse frequency (columns B and C, vs column D). In other experiments, reactor energies per pulse have been observed to reach >500J. Given that the reactor pulse voltage (Vp) is determined by the extinction voltage Vx (Vp=Vb-Vx) and thus cannot reach the amplitude of the breakdown voltage Vb, this involution of energy observed per pulse in the reactor and at its output indicates that it is a current amplification phenomenon. Indeed, with input currents of 1.2 to 1.7A and input pulse energies of 1 to 30J, peak pulse reactor currents have been observed to reach >150A.

6. DYNAMIC CAPACITANCE OF PAGD REACTORS

We have previously reported the calculated static capacitance of typical plate area reactors (p.43, lines 19 to 21). A typical 128 cm^2 plate reactor would have a capacitance of the order of 2 pF, and at an applied 560V potential, be capable of storing 0.3 micro-Joules, an infinitesimal quantity of energy ($E=0.5\ C\ V^2$,where E is in Joules, C in Farads and V in Volts). With a typical pulse input energy injection of 5 to 15 J, the reactor will develop 25 to >400 J per pulse; at pulse reactor voltages (Vp) of 100 to 500, the dynamic capacitance of the discharge tube will range from 0.2 to 80 mF.

7. ANOMALOUS REACTION FORCES IN THE PAGD REGIME

Determinations of the anomalous cathode reaction forces in the PAGD regime was carried out utilizing the reactor pulse energy or the pulse output energy, together with the metallographic data or by measuring the force in a reaction balance. The kinetic energy of each pulse was determined either directly, by integration of oscilloscopic pulse profiles, or indirectly, by long-term resistive discharge measurements of the batteries storing output power. The cathode material utilized for these experiments had a density of 1.86 g/cm^3. For a mean net pulse output energy of 86.4 J (Net energy out=input reactor energy - output reactor energy), or 24 mWh, and a mean volume of cathode metal ejected of the order of $3.1*10^{-8}$ cm^3, a single PAGD releases $5.8*10^{-8}$g of metal in 40 to 50 msec , or $1.3*10^{15}$ Al ions. Accordingly, the calculated kinetic energy of each Al ion leaving the cathode is quite high, of the order of $4.8*10^5$ eV, more than three orders of magnitude greater than that typically found in VADs **(11-13)**. Under these conditions of PAGD production and measurement, the energy density of the Al cathode being operated in a PAGD reactor, is of the order of $2.8*10^9$ J/cm^3, only three orders of magnitude less than the energy density value of the energy priming the vacuum, as calculated by Aspden **(14)**. Corresponding rms vapor velocity of the ejected Al ions was $1.7*10^8$ cm/sec. Utilizing Tanberg's formula for the reaction force F_R in dynes ($F_R= m*V/1.39$), such a typical PAGD deploys an anomalous reaction

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force of 143.6 dynes. Determination of the anomalous ion force by reaction weight measurement, under similar conditions, yielded 245.2 dynes. Anomalous cathode reaction forces >300 dynes have been observed in other PAGD experiments (with pulse output energies of 25 to >100 mWh).

In referring to the anomalous reaction forces present in VADs (Tanberg's and Kobel's work), Aspden has suggested a proportionality of the order of $100*i^2$ (where i is input current in real units), for the electrodynamic action observed in these experiments **(15)**. Graneau et al **(16-17)**, in their calculation of the average acceleration force for water-plasma arcs ($F_{av}= \mu_o/4\pi)(k*i^2)$, where μ_o is the permeability constant of the vacuum in Henrys per meter, and the force is in Newtons) have utilized k as a figure of merit for the strength of the explosions observed. As may be seen from Table 7, the k values of the PAGD are very high (100x higher than those observed in VAD studies, cp VAD groups #1 to 3 with PAGD groups # 6 and 7, Table 7), and comparable to those calculated by Graneau et al for water-plasma arc explosions. Yet, the PAGD input current values are the lowest of all groups. Following Aspden's interpretation of the law of electrodynamic action, the PAGD k values are found to be in the range prescribed by the ion/electron mass differential for Al ions (49,185), which lies in the 10^4 range.

8. WORK-FUNCTION OF CATHODE MATERIAL

Based upon data for the PAGD performance of diverse cathode materials presented in the PCT/CA93/00311 Application, together with Pauling's tabulation of element electronegativities (Electronegativity $X=0.44\phi-0.15$, where ϕ is the work-function of the element **(18)**, we determined the PAGD affinity of diverse cathodes to decrease with increasing element electronegativity (X) and cathode work-function (ϕ), as shown in Table 8. The lower the work-function of the cathode metal utilized, the greater was the observed PAGD affinity. It is expected that materials with work-functions of <1.5 (and lower electronegativities), such as Li, Be, Mg, Cs, etc, will support PAGD production like Al does, or better. The only cathode material tested not in plates but in thin rods was tungsten (W). No correlation of PAGD production affinity with any of the other physical parameters considered (eg atomic electron affinities, ionization potentials, atomic weight, density, melting and boiling points, thermal conductivity and electrical resistivity) was found, except that the two best PAGD cathode emitters had the lowest melting points and densities of all cathodes examined.

9. TYPICAL EXPECTED CATHODE LIFETIMES.

Accordingly, utilizing plates composed of either material with 3mm of thickness, and thus with a volume of $38.4cm^3$ per plate and considering that only 2/3rds of the cathode shall be used (a 2mm layer out of the 3mm thickness), the total number of pulses per plate total (TLT) and partial (PLT) lifetimes is theoretically:

1- Alzak: TLT: $6.2*10^7$ pulses; PLT: $4.1*10^7$ pulses;
2- H34: TLT: $1.2*10^9$ pulses; PLT: $8.1*10^8$ pulses;

Typically, a H34 device can produce ~0.25kWh per 10,000 pulses. The corresponding value for a PLT is thus a minimum of 1.0MWh/Alzak cathode and of 20MWh/H34 cathode. As the cathode for each combination is only 66.7% consumed, the vacuum pulse generator may continue to be used in a reverse configuration, by utilizing the other plate in turn as the cathode; thus, the minimal values become, respectively, 2.0MWh/Alzak pulse generator and 40MWh/H34 pulse generator. The same rationale applies if the configuration utilized was that of the double diode.

10. CONCLUSIONS

A summary of the typical specifications of PAGD reactors is presented in Table 9, though its values should not be construed as limits to the phenomenon such as it might manifest itself in other conditions.

Unlike other discharge tubes in prior art **(5-8, 19)**, which must be triggered by an external pulse generator, the PAGD reactor is the oscillator component in any of the pulse generator circuits discussed in the PCT/CA93/00311 Application **(1)**. Essentially, the PAGD reactor is a low breakdown field oscillator that does not require a trigger electrode, nor any external shaping of the applied current or voltage, which is simply DC. In distinction from the externally pulsed abnormal glow discharge described by Manuel's patent **(19)**, the PAGD regime is a self-pulsed or self-generated, and self-regulated discharge method. In fact, with the appropriate input resistance, a PAGD reactor as described, will operate in the PAGD regime autogenously, in the absence of any parallel capacitance, and utilizing solely a battery pack as a power source. The PCT/CA93/00311 Application in fact describes the physical and operational parameters necessary to configure a vacuum discharge tube to elicit self-generating discharges, and thus be self-pulsed, in the PAGD plasma regime, directly from a direct current supply.

Unlike prior art glow discharge tubes that are fundamentally flash-over devices that do not employ any form of emission **(6, 19)**, the discharge has both a glow and an (autoelectronic) emission component. Unlike VAD tubes **(5,7)**, the cold cathode PAGD autoelectronic emission pulse is not triggered externally, but a spontaneous occurrence observed at low breakdown fields, with emitter current densities 10 to 1000x lower than those required by the Fowler-Nordheim theory for field emission.

As observed in prior art VAD devices (eg Tanberg's or Kobel's cited work), anomalous cathode reaction forces are set up in the PAGD reactors; however, with 10 to 100x lower input currents than needed for a VAD, the PAGD-associated reaction forces manifest a proportionality constant that is 10 to 100x higher than found for VADS (10^3 to 10^4*i^2 vs 10^2*i^2). We think that these forces may account for the low input current densities observed in the PAGD regime. Evidently, as with the PAGD regime itself, these reaction forces result from the specific physical and operational parameters employed, amongst which the large gaps, large electrode areas, cold cathode status, low breakdown fields and cathode low work function figure prominently.

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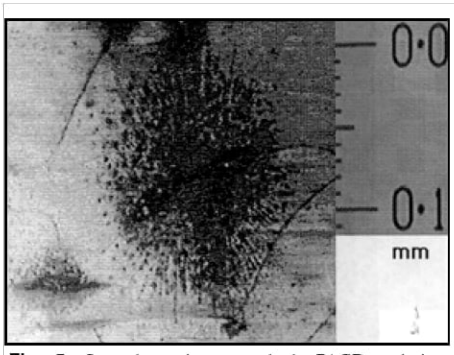

Fig. 5- Secondary pit-type cathode PAGD emission craters in Alzak plate electrodes (incident light). These craters radially exhibit fine lines of sputter deposition and the crack lines radiating from the primary emission site, on which they sit, are clearly visible. These pit-type craters have a sagittal inner diameter (2 to 10 µm) that generally is 2 to 4x smaller than their longitudinal diameter.

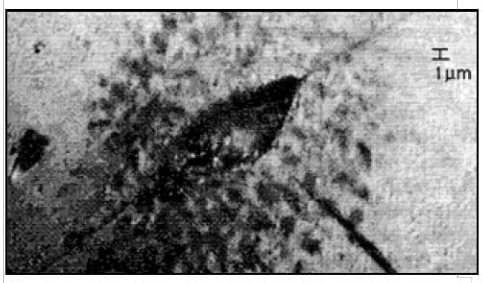

Fig. 6- Another example of a secondary pit-type cathode PAGD emission crater in Alzak plate electrodes (incident light, 40x apochromatic oel). The addition of immersion oil can be seen to obliterate, in a few seconds, the fine lines joining the sputter deposits to the pit.

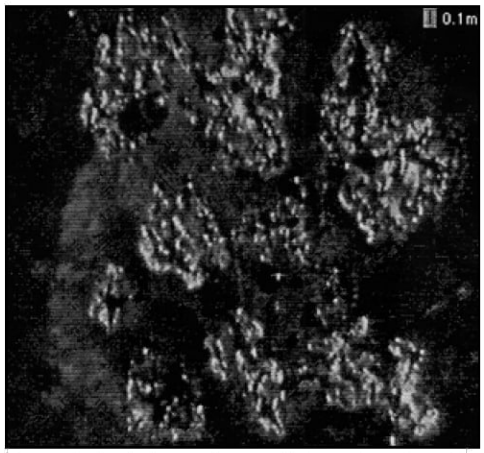

Fig. 7- Cluster of primary craters, associated secondary craters and scattered metal droplets on an Alzak plate surface showing a well delimited neighbourhood of PAGD emissions (incident and oblique light).

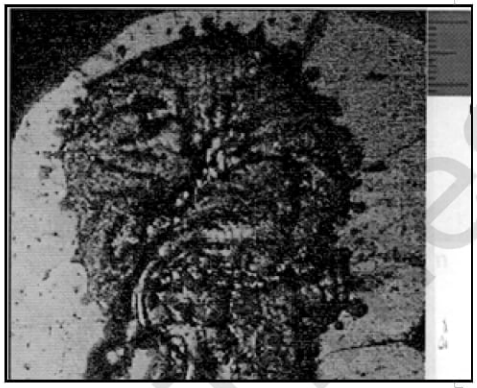

Fig. 8- Primary PAGD emission crater with diametric twirl pattern of molten aluminum, on an Alzak cathode (Incident and oblique light).

Table 2.

No.	A Area (cm^2)	B I rms Input	C J (plate) (A/m^2)
1	256	1.7	66.4
2	128	0.001	0.078
3	128	0.112	7.8
4	128	2.0	156.25
5	64	2.0	312.5
6	16	2.0	1,250
7	4	2.0	5,000

Table 5.

No.	A Volts	B Input Current (A)	C Pulse Time (msec)	D Input Energy per Pulse (Joules)
1	3,500	0.010	0.5	$1.8 * 10^{-2}$
2	1,020	0.001	1	$1 * 10^{-3}$
3	600	0.100	6	$3.6 * 10^{-1}$
4	560	0.500	20	5.60
5	560	1.700	3	2.85
6	560	1.700	30	28.56
7	560	1.200	48	32.26
8	560	4.000	50	112.00
9	250	0.500	80	10
10	250	1.100	20	5.5

Table 6.

No.	A Input Energy per pulse (Joules)	B Reactor Energy per pulse (Joules)	C Output Energy per pulse (Joules)	D PPS
1	0.1	0.3/0.5	0.16/0.2	60
2	0.33	1	1	60
3	0.38	2	2	60
4	1.84	ND	2.8	110
5	2	ND	121	0.2
6	4.3	ND	20.2	8
7	5.6	ND	154.5	0.2
8	6.5	367.7	353.8	0.2
9	8	71.5	25.2	1
10	14.4	ND	99	1
11	22.2	ND	72.9	0.8
12	26.8	ND	50	8
13	38.2	ND	80.3	1.5
14	44.8	261.5	253.5	0.3

Table 4.

No.	A Area (cm^2)	B Gap (cm)	C Vb (Volts)	D E @ Vb (V/m)	E Torr	F Residual Gas	G Status	H Cathode material
1	256	5	278	5,560	$2 * 10^{-6}$	Ar	Sealed	H.Al.
2	128	5	774	15,480	$2 * 10^{-6}$	Ar	Sealed	H.Al.
3	128	5	3500	70,000	$6 * 10^{-4}$	Ar	Rotary Pump	H.Al.
4	128	5	1600	32,000	$9 * 10^{-4}$	Ar	Rotary Pump	H.Al.
5	128	5	560	12,200	$4 * 10^{-3}$	Ar	Rotary Pump	H.Al.
6	128	5	300	6,000	$8 * 10^{-2}$	Ar	Rotary Pump	H.Al.
7	128	5.5	1350	24,545	$1 * 10^{-3}$	Ar	Rotary Pump	H.Al.
8	16	4	560	14,000	$5 * 10^{-2}$	Ar	Rotary Pump	H.Al.
9	4	8	560	7,000	$2 * 10^{-1}$	Ar	Rotary Pump	H.Al.
10	10	9	900	10,000	$1 * 10^{-4}$	Air	Sealed	Ni
11	10	18	1500	8,333	$1 * 10^{-4}$	Air	Sealed	Ni

Table 1.

No.	A W (cm)	B L (cm)	C Plate (K_L)	D Area (cm^2)	E K_A	F d (cm)	G p (Torr)
1	16	4	1	64	1	3.6	$2.8 * 10^6$
2	32	4	1.41	128	2	5	$2.0 * 10^6$
3	32	8	1.41	256	2	7	$1.4 * 10^6$
4	16	4	1	64	1	5	$2 * 10^6$
5	32	4	1.41	128	2	5	$2 * 10^6$
6	32	8	1.41	256	2	5	$2 * 10^6$

No.	H J (plate) (A/m^2) Predic	I J (plate) Exptl @ Vb	J J/p^2 Predict	K J/p^2 Exptl @ Vb	L J (plate) (A/m^2)	M J (plate) Exptl @ max	N J/p^2 Predict	O J/p^2 Exptl @ max
1	17.7	0	$2.2 * 10^{12}$	0	41.4	0	$5.2 * 10^{13}$	0
2	8.8	8.8	$2.2 * 10^{12}$	$2.2 * 10^{12}$	20.7	20.7	$5.2 * 10^{12}$	$5.2 * 10^{12}$
3	4.4	ND	$2.2 * 10^{12}$	ND	10.35	ND	$5.2 * 10^{12}$	ND
4	17.7	0	$4.4 * 10^{12}$	0	41.4	0	$1.4 * 10^{13}$	0
5	8.8	8.8	$2.2 * 10^{12}$	$2.2 * 10^{12}$	20.7	20.7	$5.2 * 10^{12}$	$5.2 * 10^{12}$
6	4.4	4.38	$1.1 * 10^{12}$	$1.1 * 10^{12}$	10.35	19.53	$2.6 * 10^{12}$	$4.9 * 10^{12}$

NA= Not Applicable ND= Not Determined

Table 3.

No.	A Area (cm^2)	B I rms Input (A)	C X-section area of plasma ball (cm^2)	D Uncorr J (em) (A/m^2)	E Method	F Emission area (cm^2)	G J (em) (A/m^2)	H Method
1	256	0.500	0.0333	$1.2 * 10^5$	Videog; uncorr	$4.4 * 10^{-4}$	$9 * 10^6$	Videog; corr
2	128	0.119	0.0095	$1.25 * 10^5$	Videog; uncorr	$1.3 * 10^{-4}$	$9.5 * 10^6$	Videog; corr
3	128	0.265	0.0177	$1.5 * 10^5$	Videog; uncorr	$2.4 * 10^{-4}$	$1.1 * 10^7$	Videog; corr
4	128	0.500	0.038	$1.3 * 10^5$	Videog; uncorr	$5.1 * 10^{-4}$	$9.8 * 10^6$	Videog; corr
5	128	1.030	0.0303	$3.4 * 10^5$	Videog; uncorr	$4.4 * 10^{-4}$	$2.6 * 10^7$	Videog; corr
6	128	0.500	0.044	$1.1 * 10^5$	NA	$5.9 * 10^{-4}$	$8.5 * 10^6$	Videog; corr
7	128	0.500	ND	NA	NA	$1.04 * 10^{-4}$	$4.8 * 10^7$	Metallog
8	128	0.100	ND	NA	NA	$3 * 10^{-4}$	$3.3 * 10^6$	Metallog
9	128	0.500	ND	NA	NA	$6.2 * 10^{-4}$	$6.5 * 10^6$	Metallog

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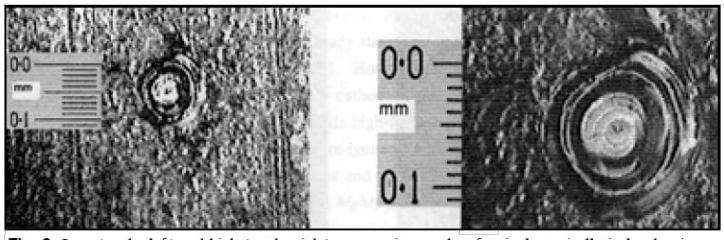
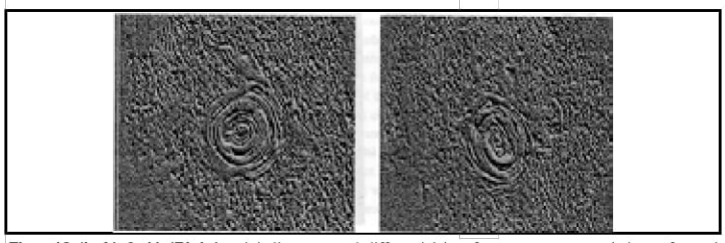
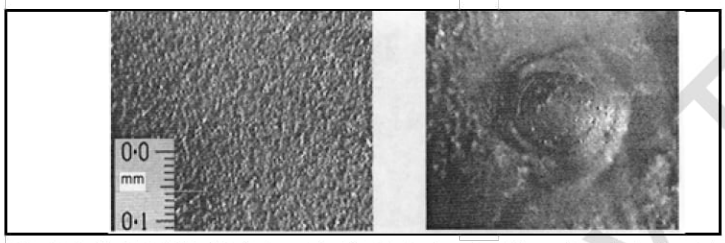


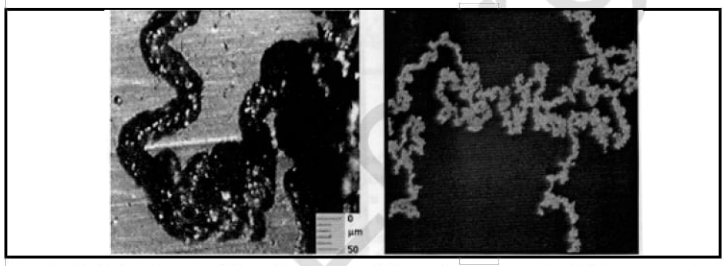
Fig. 9- Low (on the left) and high (on the right) power micrographs of a single, typically isolated, primary PAGD emission crater in a H34 Al cathode plate (incident and oblique light). The core of these craters is hollowed out (concave core) and is often occuppied by a convex molten metal droplet or spherule. On the left micrograph, one can observe a profusion of surface distortions surrounding the crater, which probably arose from the 'fall out" of material ejected by the explosive emission mechanism responsible for primary crater formation. From videographic analysis, the cathode plasma ball sits over the entire area occupied by the primary crater and the surrounding 'boiled off' periphery.



Figs. 10 (Left) & 11 (Right)- Digitally processed differential interference contrast emulations of actual micrographs for PAGD emission craters in H34 Al plate electrodes. The 'boiled off' periphery is clearly visible as a ring of protuberances surrounding the raised lip of the crater; the core of the crater is hollowed out, and the embossed spiraloid imprint of the entire formation (lips plus concave core) indicates that the tip of the PAGD channel where the cathode plasma ball sits, is the apex of a vortex that burrows into the cathode surface. It also suggests that the entire PAGD channel has an associated spin. Actual magnification:~150x.



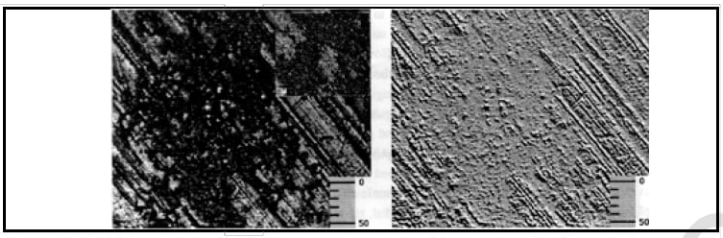
Figs. 12 (Left) & 13 (Right)- Left: Aspect of a H34 Al cathode surface being continuously pitted, eroded and covered by the 'boiling off' effect of multiple PAGD emission craters and their sediments. **Right:** A PAGD emission crater in a H34 cathode, in the process of being eroded and re-covered by the peripheral distortion adjacent to neighbouring craters (200x mag).



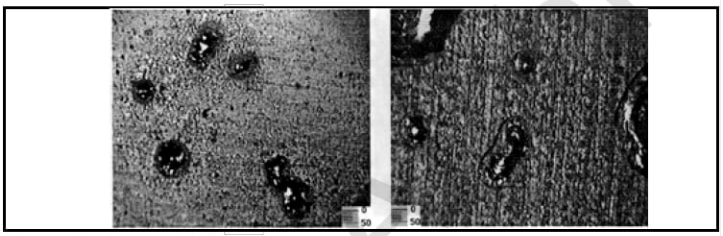
Figs. 14 (Left) & 15 (Right)- Cathode itinerant sinusoidal track signatures on an Alzak plate surface (**on the Left**) and on a semi-cylindrical silver-plated cathode (**on the Right**), due to high frequency auto-electronic PAGD emissions at high input current (1.8A on the left) occurring centered around a single event, or to evenly spaced high frequency PAGD emissions at lower input current (0.2A on the right), on highly polished surfaces. Itinerant tracks akin to Rakhovsky Type II cathode spots, appear to be a PAGD track signature at high frequency of auto-electronic emission *in highly mirrored cathode surfaces*. These signatures occur in boundary conditions close to those that will elicit a full-fledged VAD regime. The sinusoidal patterns observed also suggest that they are the result of the spin of the discharge cone, with its wobbling signature similar to that of a spinning top.

Table 7.

No.	A Current i in A	B i^2	C F_R in dynes	D ki^2	E k	F Proportionality	G Source
1	16	256	258.6	25,800	100.8	$10^2\ i^2$	Tanberg
2	19	361	356.1	35,609	98.6	$10^2\ i^2$	Tanberg
3	35	1,225	1,470	147,000	120	$10^2\ i^2$	Kobel
4	12,700	$1.6 * 10^8$	$0.9 * 10^{10}$	$9.4 * 10^{11}$	$5.8 * 10^3$	$5 * 10^3\ i^2$	Granoau
5	25,400	$6.5 * 10^8$	$4.3 * 10^{10}$	$4.3 * 10^{12}$	$6.6 * 10^3$	$7 * 10^3\ i^2$	Granoau
6	1.6	2.56	143.6	14,359	$5.6 * 10^3$	$6 * 10^3\ i^2$	PAGD
7	1.6	2.56	245.2	24,516	$9.6 * 10^3$	$10^4\ i^2$	PAGD



Figs. 16 (Left) & 17 (Right)- High power micrographs of a spread-out PAGD emission crater in hardened aluminum plates, lacking a distinct central crater and generally with a shallow concavity (incident and oblique light). Inset (incident light) shows the same emission site and two other neighbouring ones. Differential interference contrast emulation of Fig. 16 is shown on the right (Fig. 17). The central zone is merely marked by the cluster of protrusions and droplets. DCA input: 0.6A.



Figs. 18 (Left) & 19 (Right)- Micrographs.of splattered molten metal on the anode surface of Alzak, **on the Left**, and H34 Al electrodes, **on the Right**. These mound formations are due to the impact of very fast plasma metal ions (ion stream from the cathode) that deposit on the anode and punctually heat up its surface to form convex metal bubbles (local melting) surrounded by a concave border.

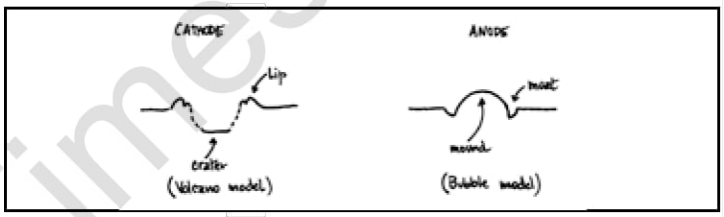


Fig. 20- Diagram of the outline of a cross section through cathode PAGD primary emission craters, on the left, and anode molten bubbles, on the right, showing their negative aspect (lips and concavity in the former, moat and convex formation in the latter).

Table 9.

Gas fill	Air, Nitrogen, Inert gas
Gas pressure, Torr	1 to 10^{-6}
Interelectrode distance	2.0 to >20 cm
Electrode Geometry	Planar-parallel, hemi-cylindrical and co-axial
Cathode area	>2cm^2
Electronegativity of cathode material	<1.0 to 2.2
Cathode work-function	<3.5 to 5.6 eV
Breakdown voltage	200 to 5,000 V
Breakdown fields	2,500 to >50,000
Current consumption	1 mA to >4A (in the PAGD regime)
Peak reactor current	1 mA to >250 A
Current density (cathode area)	0.05 to 5,000 A/m^2
Current density (emission site) as a function of input power	10^5 to $5 * 10^7$ A/m^2
PAGD rate	0.01 to >50,000 PPS
Duty cycle	1 to >40%
Pulse Time	0.1 msec to 100msec
Input energy per pulse	10^{-3} to $>2 * 10^2$ J
Reaction energy per pulse (@ reactor)	<1 to $>5 * 10^2$ J
ReactorDynamic Capacitance	100 µF to >80 mF

Table 8.

No.	A Element	B relative PAGD affinity	C Electro-negativity X=0.44φ-0.15	D Work function φ (eV)
1	Al	+++++	1.5	3.75
2	Zn	+++++	1.6	3.98
3	W	++++	1.7	4.20
4	Ni	++++	1.8	4.43
5	Fe	++++	1.8	4.43
6	Ag	+++	1.9	4.66
7	Cu	+	Cu(I) 1.9 Cu(II) 2.2	4.66 4.89

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The Possible Source of Energy for Anomalous Effects Reported in *Infinite Energy*

by Dr. Paul E. Rowe,
71 West Way, Mashpee, Massachusetts 02649

Infinite Energy has published many articles which indicate that science is on the verge of new and exciting sources of energy. This article will propose possible mechanisms for the production of that energy.

Since 1980, I have been performing experiments and literature searches which have convinced me that hydrogen gas has been produced in and from vacuum under surprisingly mild conditions. This leads me to propose that vacuum is not a void but rather a Bose-Einstein condensed matrix of protons and electrons. Such a matrix would be expected to have zero viscosity and be stable at extremely high temperatures.[1]

Many experimenters have reported the surprising appearance of hydrogen in various experiments. The amounts of hydrogen obtained were much greater than could have originally been present in their apparatuses. Hydrogen production under the following conditions has been reported:

1. By Electrical discharge in low pressure helium.[2]
2. By Electrical discharge in fairly high vacuum.[3]
3. In sealed tubes containing traces of oxygen, carbon dioxide or water, when in the vicinity of an operating Tesla coil.[4]
4. By dispersion of tungsten wire by capacitor discharge in a carbon dioxide atmosphere.[5]
5. By the detonation of aluminum containing explosives in vacuum.[4]
6. By the burning of thermite-like mixtures in vacuum.[4]
7. In the presence of glowing metal wires in vacuum containing traces of oxygen, carbon dioxide or water.[4,6]
8. By electrical discharge in vacuum containing mercury vapor.[7]

In spite of extreme efforts to remove hydrogen from his apparatus, Sir J.J. Thomson[8] was unable to produce a gas which did not contain hydrogen in his discharge experiments.

In each case, considerable energy was required to produce hydrogen. If, as I suggest, the hydrogen was produced from a matrix of protons and electrons (the aether?), this matrix is in a much lower energy state than hydrogen gas. Conversion of hydrogen gas into this matrix would be expected to produce considerable energy. If the matrix surrounds us, the effect would be similar to producing water in a lake. That is, there should be no dangerous by-products.

Collie, Patterson and Masson[9] reported the appearance of hydrogen, helium, and neon in evacuated chambers surrounding operating discharge tubes and the disappearance of hydrogen in similar tubes.

I enjoyed Peter Graneau's article in *Infinite Energy* (Vol. 3. No. 13 & 14) and admire his experimental efforts. I do not, however, accept his suggestion that breaking up liquid water into a fog produces energy. My experience in spray-drying dilute aqueous solutions convinces me that great quantities of energy are required to produce a fog from water. I suspect that under Graneau's electrical conditions, some of the hydrogen atoms in water are converted into aether and that the energy produced causes effects which lead to his observations.

Eugene Mallove's article on Randell Mills (*Infinite Energy* Vol. 2, No. 12, p.21) discusses Mill's claims of excess energy from a catalytic process employing hot hydrogen. Mill's suggests that the energy comes from the production of shrunken hydrogen atoms dubbed "hydrinos." I suspect that his energy is produced by conversion of hydrogen into aether.

Infinite Energy Vol. 2, No. 11 discusses the production of Aquafuel™ (p. 35, p.40) and Carbo-hydrogen™ (p.38). In each case, water and electricity are involved and the energy of the gas produced appears to greatly exceed theoretical. I suspect that, under the conditions employed, a tiny fraction of the hydrogen atoms in the water are converted into aether and the energy evolved results in the production of the excess gas.

Many issues of *Infinite Energy* discuss the Patterson cell, which involves storage of atomic hydrogen in palladium. The palladium is surrounded by an aqueous solution and subjected to a voltage drop. I suspect that these conditions cause some of the hydrogen atoms to be converted into aether, producing areas of concentrated energy. The pitting of the surface of the spent palladium suggests that effect is quite localized.

Mizuno, Ohmori and Enyo (*Infinite Energy* Vol. 2, No. 7, p.10) electrified aqueous solutions surrounding deuterium-saturated palladium metal. They report that some of the palladium in the vicinity of the surface was transmuted into other elements. The isotopic ratio of some the elements produced was quite different than is found in nature. I suspect that the concentrated energy, produced in portions of the palladium by conversion deuterium atoms into aether, was a factor in the transmutations (Rowe, *Infinite Energy,* Vol. 2, No. 8, p. 30).

Bockris and Minevski (*Infinite Energy* Vol. 1, No. 5 & No. 6, p.67) reported results that indicate that atoms near the surface of hydrogen saturated palladium are transmuted into other elements.

Conclusion

Many of the supposedly anomalous results reported in *Infinite Energy* magazine can be explained, if one assumes that vacuum is not a void but, rather, a matrix of protons and electrons. This matrix (the aether?) may be considered as a massive polymer of hydrogen which is in a much lower energy state than common hydrogen.

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Dare to be wise.
Horace

New Energy Times Archive

Three papers delivered by Paul E. Rowe in June 1997 at the Meeting of the Natural Philosophy Alliance (NPA) at the University of Connecticut

I. Hydrogen from Vacuum

by Paul E. Rowe, June 12, 1997

Early in World War II, the Allies learned that the Germans were incorporating aluminum flake in some of their explosives. This increased the damage a given volume of explosive would cause to some targets. At pressures equivalent to air at extremely high altitudes, incorporation of aluminum reduced the damage to similar targets. The effect was called after-burning. Most experts assumed that the initial explosion dispersed molten droplets of aluminum in the air; the droplets reacted with oxygen of the air producing aluminum oxide and releasing considerable energy. It was believed that the extra energy increased the temperature and, thus, the pressure of nearby gases, causing the greater damage. At very high altitudes the oxygen concentration was low; so the aluminum had less effect than the explosive it replaced.

Some experts believed that the pressure increased much too rapidly for this to be the correct mechanism. In 1959, I detonat-

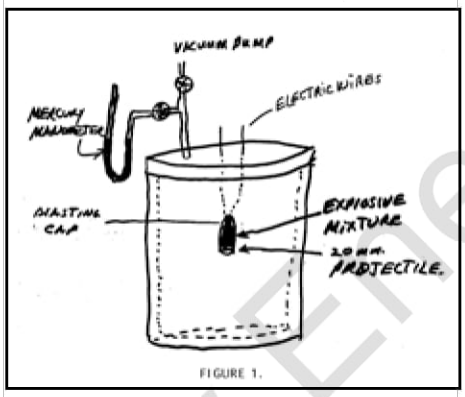

FIGURE 1.

ed 20 mm rounds (hollow steel projectiles filled with explosive) in an evacuated steel chamber.

When no aluminum was present, the volume of gas produced, by the explosion, at stp (standard temperature and pressure) was quite close to that expected from the weight and chemical nature of the explosive employed. When aluminum flake was incorporated in the explosive, the volume of gas produced, at stp., was much greater than the maximum theoretical amount. Prolonged heating of the chamber and round under continuing evacuation had a negligible effect on the volume of gas produced. Many experiments were performed in the same chamber but the quantity of gas produced was consistent and showed no tendency toward reduction with the number of experiments performed. Gases or water absorbed in the apparatus prior to detonation should have been reduced by such treatment.

Samples of gas sent out for chemical analysis yielded reasonable results, except the value reported for nitrogen was much too high. The gases found were carbon oxides, nitrogen oxides, water vapor and traces of simple organic compounds. The value reported for nitrogen had been obtained by difference and represented gases for which no analysis had been made.

Funding for the project was terminated but the results of the experiments continued to bother me. What could the extra gas have been? What was its origin?

In 1980, I performed a literature search and found many articles which seemed pertinent. In a 1922 paper, George Wendt and Clarence Irion of the University of Chicago reported on experiments involving explosion of tungsten wires in a carbon

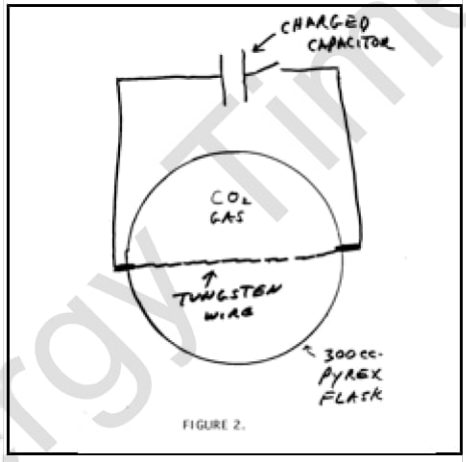

FIGURE 2.

dioxide atmosphere using capacitor discharge.

After the explosion, they dissolved the carbon dioxide and found that a quantity of gas remained. They did not identify the gas, but showed that it was not any of the products expected from carbon dioxide. The following quote is from their paper:

"The gas evolution is very irregular, but this is probably due to irregular conditions of explosion; it is impossible with the present technique to produce explosions of uniform brilliancy and temperature. The volume of gas produced is so large as to exclude its arising from gas dissolved by the wire, for the average volume of the wires was 0.0381 cubic millimeter, and the average volume of the gas was 26,500 times greater."

That is, the average volume of gas was slightly greater than 1 cc. One of the experiments yielded 3.62 cc. In those days, there was no difficulty measuring volumes as low as 0.1 cc. Could Wendt's unexpected gas have been the same as mine?

In the early part of this century, hydrogen gas was sometimes introduced into a vacuum by heating a fine platinum or palladium tube attached to the evacuated system. The following quote is from a 1903 paper by Harold A. Wilson, a highly respected British experimenter:

"In the experiments in hydrogen at low pressure the hydrogen was obtained sufficiently pure by allowing it to diffuse through platinum. A spiral of fine platinum tubing, 0.5 millimeter external and 0.25 millimeter internal diameter, was sealed on the apparatus at one end and the other end fused up. On heating this spiral in the flame of a spirit lamp, the hydrogen present in the flame diffused through into the apparatus. In this way, the pressure could be increased several tenths of a millimeter in one minute when the total capacity of the apparatus was about 300 cubic centimeters.

The spectrum of a discharge in hydrogen led in this way was examined, and appeared to consist almost entirely of the hydrogen lines."

It was known that hydrogen was absorbed by platinum; so Wilson assumed that hydrogen was produced in the flame, absorbed by the outer surface of the platinum spiral, and released at the inner surface. Where else could it have come from?

It seemed to me that Wilson's experiment bears a resemblance to Wendt's experiment and my experiment. In each case, a hot metal surface was present and gas was produced. Could the gas have been hydrogen in all three cases? Neither Wendt nor I had reason to check the gas we had produced for hydrogen. I performed experiments similar to Wilson's using an electrically heated tungsten filament. When the system contained a very good vacuum or helium, no gas was produced. When traces of oxygen or carbon dioxide were present, pressure increased with time and hydrides formed on the metal surface. Likely, Wilson's hydrogen did not come from his flame.

Many researchers, including Nobel Laureate Sir J.J. Thomson and other members of the Royal Society, reported obtaining surprisingly large quantities of hydrogen gas in electrical discharge experiments. Later, I will discuss some of these experiments, if time permits.

Could Wendt's gas and the extra gas I had obtained have been hydrogen? Any hydrogen formed during explosion in air would have reacted to form gaseous water producing heat and increasing the pressure. This would account for the observed

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effects of incorporating aluminum in explosives.

I didn't care to detonate explosives in my basement laboratory, so I set up an apparatus which consisted of a 3-liter steel

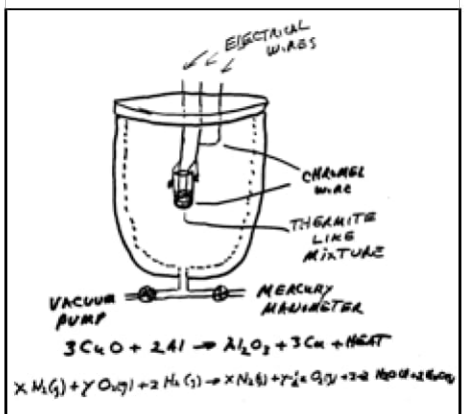

FIGURE 3.

chamber in which I could burn a thermite-like mixture.

Electrical contacts through the top of the chamber led from a variable transformer to a chromel wire surrounded by a mixture of especially pure aluminum powder and chemically pure (cp) cupric oxide. The chamber was evacuated to about 0.020 torr and sealed. The chromel wire was heated electrically. By analogy to thermite, the following reaction was expected.

$$3CuO + 2Al = Al_2O_3 + 3Cu + heat$$

Combustion should yield copper, aluminum oxide, heat and little or no gas; actually, the reaction produced a definite ping and considerably increased the temperature of the steel chamber. When the chamber cooled, the pressure was about 1/5 of an atmosphere. This much pressure would have been expected if the cupric oxide had lost about half of its oxygen to produce oxygen gas. If this had occurred, energy would have been absorbed by the decomposition and little or no heat would have been produced by the overall reaction. The gas produced was colorless and odorless.

A series of experiments was performed in which the ratio of aluminum and cupric oxide was varied. Most gas was produced when the aluminum content was well above that represented by the above equation. This suggests that the extra gas was related to aluminum. Prolonged evacuation and heating of the steel chamber and reaction mixture, prior to burning, had no effect on the quantity of gas produced. A second chromel wire was placed in the chamber away from the pyrex tube containing the combustion mixture, after burnings in which this wire was not severed by the reaction, the wire was heated electrically to yellow glow. When the system cooled, the pressure was the same as after the original burning. Excess air (assuming the gas produced was hydrogen) was let into the chamber. Electricity was passed through the wire and a slight ping and temperature increase were noted. If the original gas was hydrogen, the following reaction was expected.

$$x\,N_2(g) + y\,O_2(g) + z\,H_2(g) = x\,N_2(g) + y\text{-}1/2\,z\,O_2(g) + Z\text{-}a\,H_2O(l) + a\,H_2O(g)$$

a = water vapor expected under ambient conditions.

When the system equilibrated the pressure was very close to that calculated assuming that the original gas was hydrogen and that it had reacted with oxygen in the air to produce water, which liquefied , leaving the water vapor pressure expected under ambient conditions. This experiment was repeated several times using different quantities of air. In each case, the results led to the above conclusion. There can be little doubt that the gas produced during the original combustion was hydrogen.

What is the source of hydrogen?

The obvious answer is water previously absorbed in the apparatus, but some of such water would have been removed on prolonged heating and evacuation. Such treatment did not affect the volume of hydrogen produced by the experiments.

In 1905, Albert Einstein published his Special Theory of Relativity. The same year, Clarence Skinner of the University of Nebraska published a paper describing electrical discharge experiments he performed in low pressure, purified helium. His result led him to the following conclusions:

1. When discharge starts, the spectrum of hydrogen appears in the cathode glow.
2. The initial rate of gas production is the same for all metal cathodes and is that predicted by Faraday's Law of Electrolysis.
3. Hydrogen is produced at the cathode.
4. After a time, which depends on the metal of the cathode, tarnish starts to form on the cathode surface and the rate of pressure increase slows.
5. When a silver cathode is allowed to rest for one hour after discharge has been stopped and discharge is then restarted, hydrogen is produced very slowly. After the silver had rested overnight, the tarnish had fallen from the cathode leaving a clean surface. When discharge was restarted the pressure versus time curve was the same as for a fresh silver cathode.
6. Cathodes which retained their tarnish produced much less hydrogen on reuse.
7. When the discharge tube contained other gases, the cathode voltage drop required to maintain a given amperage soon reduced to that required when low pressure hydrogen was present.

The following quotes are from Skinner's paper:

"....It was observed that no matter how carefully the gas was purified, the hydrogen radiation tested spectroscopically, persistently appeared in the cathode glow. Simultaneous with this appearance there was also a continuous increase in the gas pressure with the time of discharge."

. . . . .

"With a freshly polished metal as cathode the gas pressure increases at first at a constant rate, but after a time this rate begins to drop off until the pressure appears to have reached a constant maximum value. Silver was depleted in this way giving off about two tenths of a cubic centimeter (measured at atmospheric pressure) of hydrogen. The current was then broken and the hydrogen absorbed by the Na,K cathode. After standing in helium over night and then tested again the next morning, it was found to have a new supply equal to the one given up the day before. Without allowing it any chance of regaining hydrogen from an external source it was thus depleted six or eight times during the course of two weeks and found to give off at each time about the same amount of gas. With a few hours rest only a slight recovery was noticed."

"After this series the silver was removed from the tube, repolished, and then tested again with the same results. Altogether about two cubic centimeters of gas had been given off by this silver disk, which is 15 mm. In diameter and about one millimeter thick. It shows no sign of having its supply of hydrogen reduced in the least."

The volume of Skinner's silver cathode was about 0.177 cc. He obtained 11.2 times this volume (at stp) of hydrogen. In 1928, E.W.R. Stearcie and F.M.G. Johnson of McGill University reported on an exhaustive study of the solubility of hydrogen in silver. They found the solubility increased with temperature and with the pressure of hydrogen. At 400 degrees centigrade and a hydrogen pressure of slightly over one atmosphere, silver absorbed 0.007 volumes (at stp) of hydrogen. Skinner obtained 1,600 times as much hydrogen from his cathode which, "shows no sign of having its supply of hydrogen reduced in the least". Almost certainly, the hydrogen which Skinner produced did not come from the silver cathode, which had been stored in air and then under vacuum, at room temperature.

Skinner's unexpected results can be explained if one assumes that atomic hydrogen is produced at the cathode by the electrolysis of something in the vacuum. Atomic hydrogen is extremely reactive and would be expected to react with the cathode surface to form a hydride. This explains the tarnishing of metals in the helium atmosphere. Initially hydrogen would be produced at the rate predicted by faraday's law but the rate of pressure increase would decrease as hydride

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formed on the cathode surface.

Silver hydride is not stable. On standing overnight it would decompose into silver and hydrogen. The resulting silver dust would fall from the cathode leaving a clean silver surface. There would be no limit to the amount of hydrogen which could be produced at the cathode, if vacuum, as suggested in my previous papers is a concentrated matrix of protons and electrons.

Skinner obtained many other results which tend to confirm this speculation. There is not time to discuss them here.

In 1914, George Winchester of Washington and Jefferson College reported results of electrical discharge experiments performed at much lower pressures and higher voltages than were employed by Skinner. He gave graphs showing that the pressure increased with time and then leveled off to a very slow linear increase. Using the spectroscope, he determined that the gases produced were hydrogen, helium, and neon. The helium and neon ceased to be produced in time. The following quote is from his paper:

"The case of hydrogen is different; I have sparked tubes until the electrodes were entirely wasted away and this gas can be obtained as long as any metal remains."

In work leading to the development of the mass spectrometer, Nobel Laureate, Sir J.J. Thomson subjected gases to electrical discharge in order to produce positive ions. He accelerated these ions through electric and magnetic fields and determined their mass by the position at which they struck a photographic plate. He was unable to obtain a plate in which the line representing hydrogen was absent. He included the following statement in a 1920 paper:

"I would like to direct attention to the analogy between the effect just described and an everyday experience with discharge tubes—I mean the difficulty of getting these tubes free from hydrogen when the test is made by a sensitive method like that of positive rays. Though you may heat the glass of the tube to the melting point, may dry the gases by liquid air or cooled charcoal, and free the gases you let -into the tube as carefully as you will from hydrogen, you will still get hydrogen lines by the positive ray method, even when the bulb has been running several hours a day for nearly a year."

I believe that Thomson's technique for ionizing gases also produced hydrogen from vacuum. As long as he continued his discharge, he kept producing hydrogen by electrolysis of vacuum.

In 1949, Saul Dushman of the General Electric Company wrote *Scientific Foundations of Vacuum Technique*. It continues to be considered by many high vac-

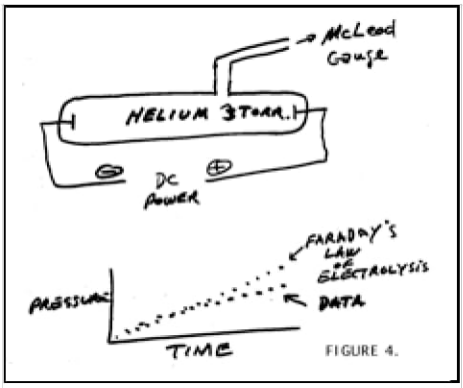

FIGURE 4.

uum experimenters as the authoritative book in its field. In this book, Dushman discussed electrical discharge experiments he performed with Andrews and Huthsteiner:

In a thoroughly evacuated glass bulb containing only tungsten electrodes and mercury vapor, they produced enough hydrogen that:

".... If piled on the glass, would form a layer at least 25 molecules deep."

Hydrogen was produced even when the voltage drop was as low as 50 volts. He noted that hydrogen was not liberated, without discharge, when the glass walls were heated to their softening point. He referred to others who had reported obtaining hydrogen:

".... To some extent in nitrogen, carbon monoxide and argon. In the presence of mercury vapor this phenomenon was extremely marked."

I believe that, under Dushman's electrical conditions, vacuum was converted into hydrogen at the mercury surface.

The results of these and many other experiments suggest that hydrogen gas is quite readily prepared in and from vacuum.

As those who attended my earlier papers will expect, I propose that hydrogen is produced by electrolysis of the ether, a Bose-Einstein condensed matrix of protons and electrons.

Energy is required to produce hydrogen from vacuum. Can energy be produced by converting hydrogen into vacuum?

A Brief History of the Ether

by Paul E. Rowe, June 12, 1997

My next paper will try to demonstrate that hydrogen gas has been produced in and from vacuum. My previous paper suggested that the ether may be a Bose-Einstein condensed matrix of effectively touching protons and electrons. The present paper will attempt to show that such a medium agrees with the concepts of many great scientists of the past.

In 1690, Christiaan Huygens published, *Traite de la Lumiere*. It included the following observations: 1. In order to have a mechanical explanation for the passage of light, a medium must be present which carries light waves, just as a medium is present to carry sound waves. Sound does not pass through an evacuated chamber because its medium has been removed. Light passes readily through an evacuated chamber; so its medium must still be present. 2. When a U-shaped glass tube, sealed at one end and filled with mercury up to the sealed end, is evacuated through the open end, light passes through the vacuum which develops between the mercury and the seal. This indicates that the medium must easily pass through the mercury and/or the glass. This, in turn, suggests that the individual particles of the medium must be quite small compared to the distance between the atoms of these materials. 3. Huygens compared the transmission of light to the action which occurs

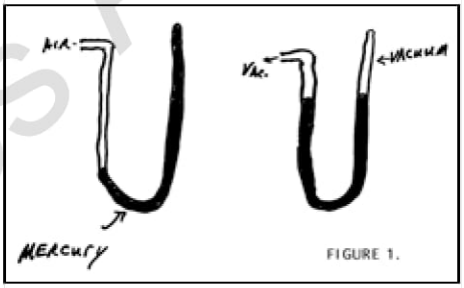

FIGURE 1.

when a hard sphere strikes a line of similar hard spheres. The motion is passed through the individual spheres to the last sphere. The motion is transferred very rapidly but not instantaneously. One at a time, each of the spheres contains all of the energy from the original collision. He suggested that light is transferred similarly and that each energized particle transfers all of its energy to another such particle.

This arrangement of touching, suspended ball bearings is a one-dimensional demonstration of the effect. When an end ball impacts on its neighbor, the ball at the other end seems to immediately bounce off. Of course, the action is not instantaneous, the time required depends on the physical properties of the material from which the balls are made. If one accepts that the particles of Huygens' ether are small enough to fit easily between atoms and are touching, the concentration of these particles must be great, indeed.

Many present day scientists admit that action at a distance [for example, magnetism or gravity] through a void has not been satisfactorily explained. Huygens' ether of effectively touching particles eliminates this problem. The forces are transferred through the ether.

His ether also leads to a simple explanation for the dual [particle and wave] nature of light. At any given instant, the energy formerly present on any particle is

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passed to one and only one other particle. The number of activated particles stays the same as the effect travels through the ether. If the effect travels in all directions, the concentration of active particles decreases with the square of the distance. The energy of light decreases in this fashion.

If, at a given instant, activated ether particles are adjacent to an atom or molecule, they may transfer their energy to that atom or molecule just as a projectile could. In a three-dimensional ether arrangement, there would be more than one neighboring particle with an equal chance of receiving an activated particle's energy. An instantaneous snapshot would show the positions of the activated particles but would not permit one to determine to which particles their energy would be transferred. This may remind some of you of the Heisenberg Uncertainty Principle.

On this basis, Huygens suggested that each point of a wave front is a new source of waves. This became known as Huygens' Principle. Using this principle, he explained the refraction of light. This principle was employed in the early l9th century to explain optical phenomena which had just been discovered. The fact that Huygens' concept explained phenomena which were not discovered until years after his death was, at the time, considered confirmation of his concepts.

I believe that Huygens' ideas conform quite well with the ether matrix I have proposed.

In an 1855 paper, Michael Faraday quoted a letter of Sir Isaac Newton to the effect that, the idea that gravity could act at a distance without an intervening agent is absurd. Faraday had an open mind on the subject. The following quote is from a speech he gave in 1851, while discussing magnetic force:

"I am more inclined to the notion that in the transmission of the force there is such an action, external to the magnet, than the effects are merely attraction and repulsion at a distance. Such an action may be a function of the ether; for it is not at all unlikely that, if there be an ether, it should have other uses than simply the conveyance of radiations."

James Clerk Maxwell wrote the section on the ether for the Ninth Edition (1875-1889) of the *Encyclopedia Britannica*. He closed with the following paragraph:

"Whatever difficulties we may have in forming a consistent idea of the constitution of the aether, there can be no doubt that the interplanetary and interstellar spaces are not empty, but are occupied by a material substance or body, which is certainly the largest, and probably the most uniform body of which we have any knowledge."

Maxwell's equations are still employed in calculating the speed of light in various media and the reflectivity at interfaces between media. To make these equations work, he had to give definite values to the dielectric constant and magnetic permeability of vacuum. I, for one, find it impossible to believe that void can have such properties.

In a 1884 speech given in Philadelphia, Lord kelvin (noted scientist who served as the President of the Royal Society) included the following statements:

"You can imagine particles of something, the thing whose motion constitutes light. The thing we call the luminiferous ether that is the only substance we are confident of in dynamics. One thing we are sure of, and that is the reality and substantiality of the luminiferous ether."

"....You may regard the existence of the luminiferous ether as a reality of science; that is, we have an all-pervading medium, an elastic solid, with a great degree of rigidity - a rigidity so prodigious in proportion to its density that the vibrations of light in it have the frequencies I have mentioned with the wave lengths I have mentioned."

The following quote is from a 1890 speech by Heinrich Hertz, discoverer of radio waves:

"It is morally certain that the wave theory of light is true, and the conclusions that necessarily follow from it are equally certain. It is therefore certain that all space known to us is not empty but is filled with a substance, the ether, which can be thrown into vibration."

The above quotes demonstrate that the existence of a material ether, which carried light, magnetism and, likely, gravity was accepted as fact by the scientific community, at the turn of the twentieth century.

Since the earth was not considered to be the center of the universe, it was believed that the earth must be moving through the ether. In 1881, A.A. Michelson and E.W. Morley began a series of experiments designed to measure the rate of movement of the Earth through the ether. They knew the velocity the Earth required to keep its orbit around the Sun. If the earth were traveling through the ether at even a reasonable fraction of that velocity, their experiments would have detected that motion. They detected no such movement. Their results were an important factor in initiating a trend which eventually discredited the ether concept.

One reason for the demise of the ether concept may have been the tendency of the intelligentsia of the time to prefer abstract concepts. Psychoanalysis, abstract art, and modern music had recently become popular. Why not modern physics? During the early years of this century, a controversy raged between the "etherists" (mostly from England) and the "anti-etherists" (mostly from continental Europe). This might have been expected, since psychoanalysis, abstract art, and modern music also originated on the continent. "The Ether of Space", a 1909 book by Sir Oliver Lodge included the following: "Again, take a steel bar itself: when violently stretched, with how great tenacity its parts cling together! Yet its particles are not in absolute contact, they are only virtually attached to each other by means of the universal connecting medium — the ether — a medium that must be competent to transmit the greatest stresses which our knowledge of gravitation and of cohesion shows us to exist.

Lodge explained Michelson and Morley's results as follows:

"The persistence of terrestrial and planetary motions shows that the ethereal viscosity, if existent, is small; or at least that the amount of energy thus got rid of is a very small fraction of the whole. But there is nothing to show that an appreciable layer of ether may not adhere to the earth and travel with it, even though the force acting on it be but small."

That is, if the ether in the vicinity of the earth tends to move with the earth, as does everything else at the surface of the earth, the results of the Michelson and Morley experiments are just as expected.

In the 1924 book, *Atoms and Rays*, Lodge continued to use the ether concept in explaining physical phenomena:

"All the light that we experience can be resolved into vibrations or tremors in the ether. That is how we first knew about the ether. But all electric and magnetic phenomena, and therefore all chemical activity, are likewise known to be modes of manifestation of the ether of space, the complete manner and meaning of which have still to be worked out."

"So the question arises, what is matter? Is that too a manifestation of some peculiar properties in the ether? We know now that matter is built up of protons and electrons. But when we come to analyze these into their fundamentals, we find more than a hint that they are but special modifications in the all-pervading ether, and are essentially resolvable into ethereal energy of a specific kind. Hence we are beginning to think that matter itself is a form of energy."

This approaches my suggestion that ether and matter have the same components: protons and electrons.

In a 1950 interview, Albert Einstein said that Michelson and Morley's results were just as he would have expected but he was influenced the most by the observation of

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stellar aberration and Armand Fizeau's measurements of the speed of light in moving water. To me, Fizeau's results appear to corroborate Lodge's conclusions. In 1851, Fizeau found that the speed of light in moving water was greater when the light travelled along with water than when the light moved against the flow of water. This would be expected if the matter, in this case water, tended to carry ether along with it as suggested by Lodge.

I believe that stellar aberration is also consistent with Lodge's view. In order to determine the position of a star, an astronomer must first determine the orientation of his telescope when the star is centered and then correct for effects that he knows affect the starlight as it enters the earth's vicinity (for example, the bending of light by the atmosphere). After all known factors have been taken into account, the star still appears to move in a small ellipse and its position on that ellipse depends on the time of year on earth. No

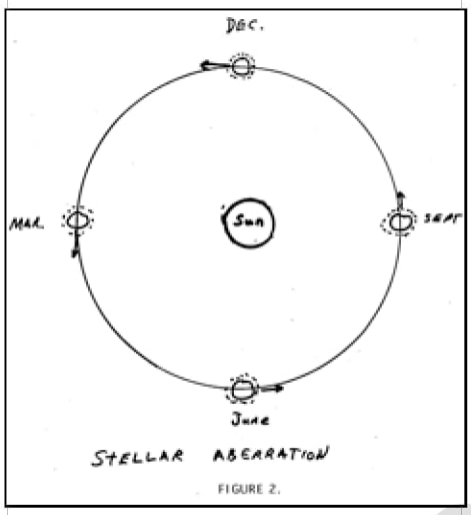

FIGURE 2.

one believes that stars move in ellipses based on the time of year on earth. There must be a factor for which astronomers have not corrected. If ether in the vicinity of earth moves with the earth, it also moves relative to the ether in free space. For this reason, light would be bent as it moved from free space into the vicinity of the earth. The direction of bending would be opposite in March than in September, when the earth is moving in the opposite direction relative to free space. This effect would cause a fixed star to appear to move in an ellipse to an observer on the earth.

The chief reason that Lodge's explanations were not accepted was probably the difficulty in believing that anything could have the properties required of his ether. How could such a dense medium be present without its being obvious to us? How could the earth or, indeed, one's hand move through such a medium? I hope that yesterday's paper answered these questions satisfactorily.

Time, Mass, and Velocity

by Paul E. Rowe

(Ed. Note: This was actually delivered the day before the two preceding NPA Meeting papers.)

Tomorrow I am going to present two papers. The first is a brief history of the ether. It quotes many famous scientists and concludes that the ether may be a matrix of particles. The second attempts to demonstrate that hydrogen gas has been made in and from vacuum. It gives experimental evidence from many scientists, some quite highly respected, and suggests that the ether is a concentrated matrix of protons and electrons.

Today, I will try to explain many physical phenomena assuming the existence of such an ether.

Common salt is a stable arrangement of positive and negative particles. Each sodium ion is surrounded by chloride ions and each chloride ion is surrounded by sodium ions in either the crystalline or molten state. The particles are considered to be effectively touching. Could the ether be a similar arrangement of protons and electrons?

The radii of electrons and protons are believed to be about 1/5000th the radii of ions. A salt-like arrangement of protons and electrons would be very concentrated,

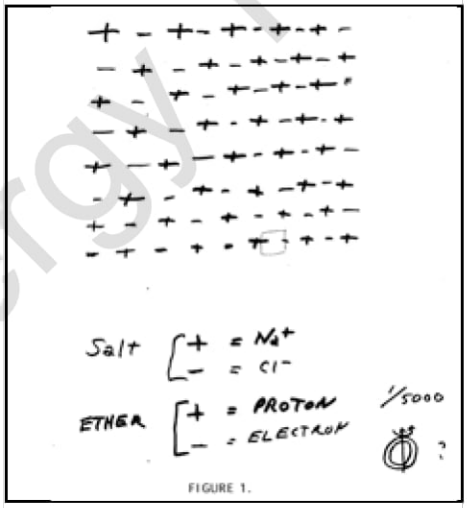

FIGURE 1.

indeed. From the radii and masses of protons and electrons, one may calculate that the density of such a matrix would be extremely great. If such a matrix is the medium for light, it must fill the knowable universe. The mass of visible matter would be much less than 1% of the mass of the ether. Can the ether be the missing mass or dark matter for which physicists are searching?

Electric Field

Figure I is a two-dimensional representation of a possible ether arrangement. It is a checkerboard in which the dark squares are electrons and the light squares are protons. Picture two parallel metal plates separated by such a matrix connect a battery across the plates. Wouldn't the proposed ether be distorted in such a way as to partially cancel the effect of the charges? If so, the ether is polarizable and has a dielectric constant. Maxwell's equations, which quite accurately predict the effect of materials on light, require that vacuum has a definite dielectric constant. Is such a distorted medium an electric field? Could a void produce such effects?

Magnetic Field

Picture a permanent magnet surrounded by such a medium. It is believed that some of the unpaired electrons in the magnet have a preferred orientation. Wouldn't some of the neighboring unpaired electrons of the ether tend to align oppositely? If so, the ether has definite magnetic permeability as required by Maxwell's equations. Is such a distorted matrix a magnetic field? Can a void show such effects?

I find it impossible to believe that differ-

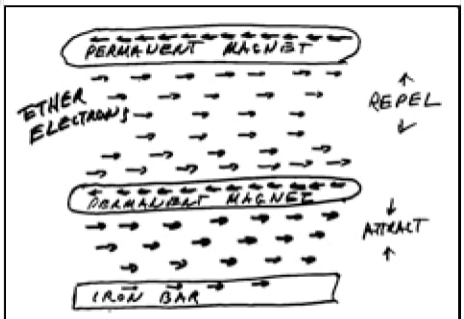

FIGURE 2.

ent sections of a void can have different electrical and magnetic properties.

Dual Nature of Light

In the 1600s, Huygens proposed that light required a medium of particles. He suggested that energy was passed from particle to particle through the medium. A one dimensional arrangement of touching, suspended balls is a simple example of such an arrangement. If one of the end balls is dropped onto its neighbor, the ball on the far end seems to immediately leave the arrangement. Of course, the effect is not immediate. All the energy on a ball is passed to one and only one neighboring ball. The rate of transfer of the effect depends on the properties of the material from which the balls are made. An ether would be 3-dimensional and each particle would have more than one equivalent neighbors. It would not be possible to predict to which neighboring particle an activated particle would pass its energy. This may remind some of you of the heisenberg uncertainty principle.

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On this basis, Huygens explained the properties of light which were known at that time. Later his ideas were used to explain Fresnel patterns, which were discovered many years after his death. I suspect that he would have explained the photo-electric effect as follows:

At any instant, all of the light energy from a given event is on the same number of matrix particles. All particles carrying energy of the same frequency have the same extra energy. If one such particle can cause a certain effect, any such particle can cause that effect. The higher the intensity of the light the greater the chance for an effect. Regardless of the intensity of light or the distance the light has travelled, any properly activated electron can cause the effect. On this basis, the photoelectric effect is expected.

If, as I suggest, the ether is a matrix of protons and electrons and light energy is passed from electron to electron, light may be considered a magnetic effect. However, in the process each affected electron moves closer to some neighboring protons and farther from others making it an electromagnetic effect.

Electron Waves

In a cathode ray tube, the electron which leaves the cathode may not be the one

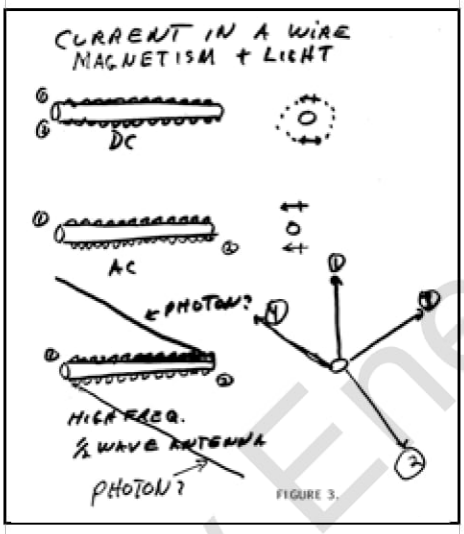

FIGURE 3.

which affects the phosphor. Energy may be passed from matrix electron to matrix electron in a domino effect. One could not predict which neighboring electron will receive an activated matrix electrons energy. The effect would be a wave phenomenon, since energy is passed from particle to particle just as in sound and ocean waves.

How can we move through the ether and not feel its presence?

Bose-Einstein Condensation

The January, 1982 issue of *Scientific American* included an excellent article on Bose-Einstein condensation by Silvera and Walraven. A Bose-Einstein condensed material is at its lowest possible energy state at a temperature above 0 degrees absolute. It cannot permanently take on energy and remain in this state. The article gives a formula for calculating the maximum temperature at which an arrangement of particles can remain Bose-Einstein

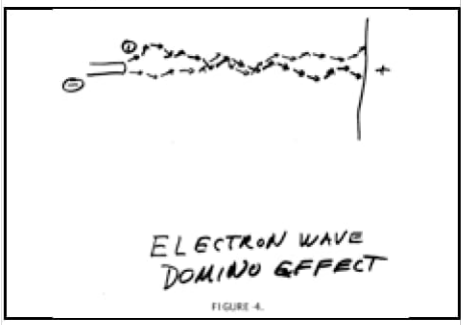

FIGURE 4.

condensed. Substituting appropriate values for protons and electrons in this formula reveals that the proposed matrix would remain Bose-Einstein condensed at extremely high temperatures.

Liquid helium below 2.18° absolute is a superfluid. Once started flowing through fine powders, it continues flowing indefinitely. The article suggests that it may have this property because it is Bose-Einstein condensed.

As pointed out earlier, the proposed matrix has an extremely fine structure compared to the space between atoms in materials. Matter would be an extremely open sieve to such a matrix and would move through the matrix without friction. The matrix cannot take energy from a moving object; so a body in motion would continue in motion at the same velocity. Any force applied to the object would continue to accelerate the object until the force was removed. The object would continue to move at the new velocity until another force was applied.

The Ether and the Earth

The results of the Michelson and Morley experiments were influential in the demise of the ether concept. In 1909, Sir Oliver Lodge pointed out that these results are as expected, if the portion of the ether in the vicinity of the earth moves with the earth. In the mid 1800s, Armand Fizeau obtained the first reasonably accurate value for the speed of light. He found that when light traveled through moving water, it travelled faster when moving in the same direction as the water than when traveling against the stream. This suggests that the medium which carries light tends to move with nearby water molecules. If Lodge is correct, the ether is mostly affected by the very massive earth but Fizeau's results suggest that the nearer water molecules also affect the ether.

The proposed ether has considerable mass and the portion in the neighborhood of the Earth would be expected to move with the earth, as does every other mass on or near the Earth. Air and water show a Coriolis effect due to the spinning of the Earth. Does the ether show a similar effect? The results of more recent experiments indicate that this may be the case.

Effect of Velocity on Ether Properties

Time, as we measure it, slows as the speed of light is approached. Some suspensions increase their resistance to the passage of objects as the speed of the object is increased. I understand that even air and water show such an effect. In the case of suspensions, the property is called dilatanism. When the mixing speed in a dilatant suspension is increased sufficiently, the suspension takes on the properties of a solid and either the stirrer or the mixing machine breaks. The suspension, then, becomes quite fluid again.

The most dramatic demonstration of this effect, that I have experienced, involves a concentrated suspension of extremely tiny glass balloons in water. When one slowly places a finger into the suspension, one feels as if the suspension were water. If one taps the surface of the suspension, he feels that he is tapping a solid. I have no doubt that, if one tapped hard enough, he would break a finger at the surface.

Many difficult to understand physical phenomena can be readily explained by assuming that the ether is dilatant and, therefore, shows increased resistance to objects as they approach the speed of light.

Time and Velocity

Picture a pendulum clock moving through a dilantic ether. As the clock's velocity approaches the speed of light, relative to the ether, the period of the pendulum and time, as the clock measures it, slows. We now base time on the period of vibration of a standard chemical bond. This period would, similarly slow, as the object containing the bond approached the speed of light relative to the ether.

Let us consider Einstein's twin paradox. The twin who remains on earth has a clock which remains almost at rest, relative to the ether in its vicinity. The speeding twin's clock slows as it moves rapidly through the ether. This is true whether he is moving toward or away from his brother. If one bases time on these clocks, time slows for the speeding twin. The vibrations of all the bonds in the speeding twins body slow with speed, relative to the ether. This is similar to a cooling of everything in his spaceship. All chemical reactions slow. The speeding twin may or may not survive this ordeal but, if he returned to earth, he would appear much younger than his earth bound brother.

I suggest that time be based on the vibration period of a standard chemical bond, when it is at rest relative to the ether in its vicinity. By this definition, time does not vary with velocity.

Mass and Velocity

I suggest that mass be based on the force required to accelerate a standard object, when it is at rest relative to the ether in its vicinity. By this definition, the force required to accelerate an object increases as its speed, relative to the ether, increases but the mass of the object does not change with velocity.

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***Part II** of a New Section for an old subject that is now being revisited in cold fusion and transmutation laboratories around the world..... (See* **Infinite Energy** *Issue #15/16 for Part I)*

ALCHEMY — HISTORICAL REPORTS

The Disintegration of Tungsten to Helium

Edited by **Robert Nelson**
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In April 1922, Gerald L. Wendt and Clarence E. Irion (University of Chicago) reported their "Experimental Attempts to Decompose Tungsten at High Temperatures" to a meeting of the American Chemical Society in Illinois.

Wendt and Irion claimed to have completely disintegrated tungsten wire into helium by means of a high-voltage discharge in glass bulbs. In the mean of 21 experiments, 1.01cc. of helium was obtained from a wire length of 39.62 mm. with a weight of 0.713 mg., exploded with 29.6 kilovolts. The procedure consisted of charging a condensor to 100 Kv and discharging it at high speed through an extremely fine wire. The resulting explosion generated a pressure of about 1,000 lb./sq.in. and a temperature over 50,000° F. The method introduced as much as a coulomb of electricity into the tungsten wire within 1/300,000 th of a second. The accompanying flash of light was about 200 times as bright as sunlight, and lasted less than 1/100,000 th of a second. No smoke or other residue was ever found after the explosions.

Wendt and Irion described the electrical circuit and bulb (Fig.1,2) as follows:

"The primary circuit of the transformer, T, operates on a 220-volt alternating current power line through an inductive resistance, E. In order to prevent a destructive back-pulse into the power line should the charged condenser accidentally be discharged through the secondary circuit of the transformer, 2 condensers of 1 microfarad capacity each are bridged across the primary circuit with a ground connection, as shown at A. The primary circuit was heavy enough to carry 40 amperes during the brief period necessary to charge the large condenser; the secondary circuit furnished 100,000 volts though ordinarily only some 30,000 volts was used. The secondary circuit was connected to the two sides of the large condenser, C, one side leading through the hot cathode 'kenotron' rectifier, R, which was especially designed for heavy service and a large factor of safety. Its cathode filament was heated by the battery of dry cells, B. The discharge circuit led from the two sides of the condenser and contained only the spark gap, S, and the wire to be exploded, H. This discharge circuit was made as short and compact as possible, of heavy copper strip, in order to reduce resistance and inductance to a minimum and thus allow a rapid and non-oscillating discharge through the wire in the minimum time, thus concentrating the energy input and giving the maximum temperature in the material to the wire. To give maximum capacity and hold maximum voltage, the condenser was built of 100 glass plates 60 by 75 cm. covered with heavy tin foil and cast into solid paraffin with a gap of 5 mm. between plates. The condenser showed brushing at the edges of the plates at 30,000 volts but held 45,000 volts without puncturing. The capacity was about 0.1 microfarad. The spark gap consisted of two 2 cm. brass spheres, their separation adjustable to the maximum voltage of the condenser. Its use is important since it is the only means for protecting the condenser from excessive charge by the transformer, and for insuring a complete and sharp discharge at the proper moment.

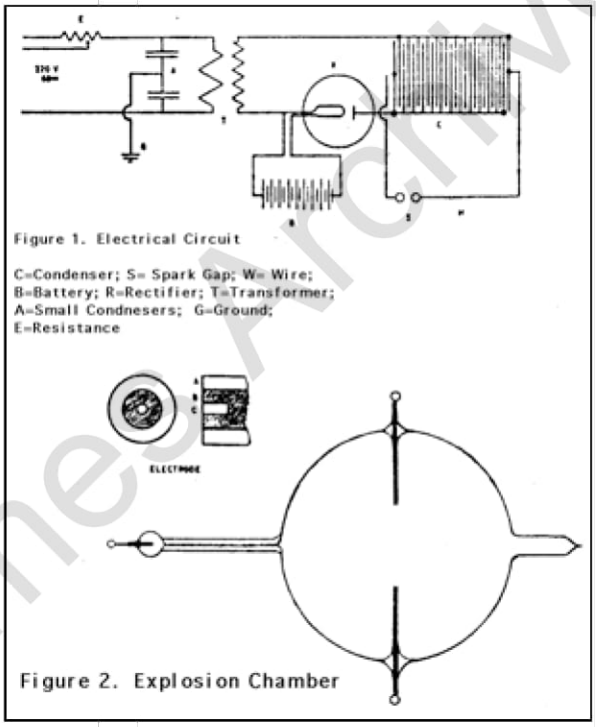

Figure 1. Electrical Circuit

C=Condenser; S= Spark Gap; W= Wire; B=Battery; R=Rectifier; T=Transformer; A=Small Condnesers; G=Ground; E=Resistance

Figure 2. Explosion Chamber

"Tungsten was chosen for the material of the wire to be exploded chiefly because its high atomic weight made its decomposition probable on the hypothesis adopted, and also because it is hard enough to allow convenient manipulation and support even in excessively thin wires. The wires were 0.035 mm. in diameter, about 4 cm. long and weighed 0.5 to 0.7 mg. They had sufficient strength to be sprung into place between the larger electrodes shown in Fig. 2 without welding or clamping.

"The construction of the explosion bulb is shown in Fig. 2. It has a volume of about 300 cc., and was constructed of heavy Pyrex glass without strain and in good spherical form, for it was required to withstand momentarily a tremendous outward pressure. Thick bulbs invariably broke during the explosion, because of insufficient elasticity. Thin bulbs may be used if the bulb is immersed in a vessel of water, which gives sufficient support together with elasticity. The large side-tube is the neck at which the bulb was sealed from the pump system after evacuation, and through which the wire was sprung into place between the electrodes by means of pincers. The smaller side tube contained a third sealed-in electrode, and served for the spectroscopic examination of the gas within—one of the electrodes being used for the other terminal of the exciting induction coil.

"The three electrodes were constructed as is shown in detail in Fig. 2. B was the electrode itself, made of No. 20 tungsten wire. This was firmly sealed directly through the Pyrex walls, in the manner shown, for mechanical strength. The entire surface of the electrodes was first covered with a thick layer of Pyrex glass, A. The tip was then carefully ground off until the tungsten was exposed. Then a hole, C, was drilled in the end with a No. 80 drill, 0.343 mm. in diameter, the hole being less than 0.76 mm. deep, to receive the fine wire for explosion. The electrodes were then sealed into the bulb. This method of sealing in the electrodes had the two purposes of excluding the chance of leakage

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of air inward through the seal after evacuation and of preventing the liberation of gas from these electrodes by the heating effect of the explosion itself. With such electrodes only the surfaces of the three small holes were exposed to the effects of the explosions, and one of these, in the spectroscopic capillary, was far removed from the scene of the explosion. In some of the early explosions brass electrodes were used welded to a tungsten wire sealed through the glass."

The bulb was vacuum-evacuated for 15 hours by a mechanical pump and two mercury-vapor diffusion pumps in series with a liquid-air trap to capture any mercury vapor. The bulb was supported in a furnace and heated to above 350° to drive off any gases contained in the glass, and outgassed coconut charcoal (immersed in liquid air) was employed in-line to absorb gases just prior to sealing the bulb. In addition, about 0.2 amperes from a battery was passed through the electrodes and the filament to heat them above 2,000° for 15 hours to drive off any other absorbed gases. Bulbs prepared in this manner showed no spectrum, fluorescence, or conductance.

After the wire was exploded, spectroscopic analysis of the gas revealed the strong yellow line of helium, and the faint green line of mercury. Other faint lines were detected but not identified: two red, one bright blue, and one pale violet. On some occasions, two unidentified faint yellow lines and a second violet line were detected. Hydrogen and neon were absent.

Wendt and Irion commented that "The appearance of helium and the absence of hydrogen is interesting for two reasons. In the first place, it seems to dispose of the objection that the helium arose from gas remaining in the wire, for in that case hydrogen should also have been visible, for it was probably originally present in the wire in much larger quantity than was helium. In the second place, if the helium does arise from a decomposition of the tungsten atoms, the absence of hydrogen is also interesting because the atomic weight of tungsten is exactly 46 times the atomic weight of helium, and Rutherford was also unable to detect hydrogen from the bombardment with α-rays of carbon, oxygen, magnesium, silicon, and sulfur, whose weights are multiples of 4, though he did detect it with boron, nitrogen, fluorine, sodium, phosphorus and aluminum, whose weights are not such multiples."

The possibility that helium could have been present in the tungsten could have been excluded by exploding the wire using a greater inductance to obtain a slower explosion at a lower temperature, giving complete vaporization without decomposition. However, there was not enough time available to conduct such tests. The vacuum method of preparing the tubes rigorously excluded contamination, but did not allow the collection, measurement and analysis of the gas produced. Therefore, Wendt and Irion also conducted explosions in carbon dioxide at atmospheric pressure in slightly modified bulbs; this enabled them to study the helium they produced. The carbon dioxide was carefully purified and blank-tested. This method also excluded the possibility of contamination from leakage of air into the bulbs, or by the release of gas from the glass bulb or the electrodes, because the explosion was too rapid to liberate any helium from those sources by heat from the tungsten vapor. The brief duration of the high temperature could not cause the carbon dioxide to decompose into carbon monoxide and oxygen, and the scientists performed pertinent tests to prove the point.

Unfortunately, the Associated Press widely published an exaggerated account of the "transmutation" experiment, based on the oral presentation which Wendt and Irion had made to the American Chemical Society in April, 1922. In a footnote to their article published in the *Journal of the A.C.S.* (September 1922), they emphasized that "this report is preliminary, and that nothing is proved beyond the importance of the problem and the promise of this method... For the sake of clarity it is suggested that the term disintegration be reserved for the spontaneous processes of radio-activity, that decomposition be applied to the splitting of complex atoms into simpler parts, and that transmutation be understood to imply some degree of synthesis of atomic nuclei."

Wendt and Irion planned a compete analysis of the gas they collected, but the sample was lost in an accident. "Then the work was stopped by the failure of health of the senior author..." Two years later, S.K. Allison and William Harkins reported inconclusive negative results from their version of the experiment. The issue remains unresolved.

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The Transmutation of Lead to Mercury

by **Robert Nelson**
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In 1924, Prof. Arthur Smits and Dr. A. Karssen (University of Amsterdam) published reports of their alleged transmutation of lead into mercury and thallium. Their work was inspired by that of Prof. Miethe, who claimed to have transformed mercury into gold in a modified Jaenicke mercury ultraviolet lamp.

The lamp was constructed of lead quartz. Two legs (A,B), ending in narrow tubes, contain two steel electrodes cemented with sealing wax. The electrodes were inserted in two small removable copper water coolers (G, H). Pure liquid lead was poured into storage vessel C, after which the open end was sealed off. The lead was kept liquid at 350°C. by an electric furnace around C. Tube D contained capillary F and terminated in stopcock K, which was connected to a mercury diffusion pump (Fig. 1).

When a high vacuum was attained, vessel C was further heated with a Bunsen burner to dissociate all the oxide and gases. Stopcock K was then closed and disconnected from the pump. The apparatus was tilted so the liquid lead ran into the two legs (A, B) of the lamp. The legs of the lamp were heated to redness to drive off the gases from the electrodes, and the lamp was evacuated again. Then copper water coolers were placed around the legs, and the lamp was ready to use. At the end of the experiment, the liquid lead was returned to vessel C, which was continuously heated. The lead was specially prepared and purified by the firm of Kahlbaum of Berlin to prevent every contamination, especially mercury.

The experiment was monitored with a quartz spectroscope. After a current of 30-35 amperes at 8 volts was passed through the system for 6 hours, a few mercury lines began to appear in the spectrum. After 10 hours, the entire series of lines of mercury, plus those of thallium, were apparent in the visible and ultraviolet spectrum.

In 1926, Smits and Karssen reported further developments of their experimental protocol. The lamp was redesigned, and the mercury diffusion pump was replaced by a mechanical pump to eliminate the possibility of contamination from that source. The use of a mercury manometer was avoided by employing a glass spring manometer. All the equipment was examined spectroscopically to make certain it was free from mercury and thallium. They described their method as follows:

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"After filling the storage vessel, the lamp and the lead were heated in high vacuum to redness. The lead oxide being dissociated, the liquid lead was as brilliant as mercury. Then the lead was brought into the lamp, and after ignition the spectrum was observed at 25 volt and 36 amp., by a Hilger quartz-spectrograph. Further, the spectrum of a quartz mercury lamp was observed, and also the scale in such a way that, to facilitate comparison, the different spectra were adjacent. Thus we obtained the spectrum of the lead in its initial state. After that we burned the lamp at 40 amp. and 80 volt for 10 hours. After having done this the lead was poured into the storage vessel to obtain thorough mixing; the lead was then brought into the lamp again, and after ignition the spectrum was observed at 25 volt and 36 amp. The result was that, whilst initially the lead spectrum showed only very weakly the mercury line 2536 in the ultra-violet, after 10 hours' burning, the strongest mercury lines had appeared in the visible as well as in the ultra-violet part of the spectrum, and also the most characteristic thallium line, indicating a transmutation of lead into mercury and thallium.

"Since our experiments showed that a high current density is very favourable to this transformation, we used currents up to 60 amp., but that seemed to be dangerous, because only by intensive air cooling could melting of the quartz-lamp be prevented.

"We thought it better, therefore, to change our method a little, by applying not a continuous electrical current but sparks of high current densities... While the lamp was kept oscillating by a mechanical arrangement... a current of high-density [60-100 amp.] was breaking and making... This method was very successful... After 9-1/4 hours' sparking all mercury lines, even the very weak ones, were present...

"This, however, does not yet prove the transmutation to be strong, as it is known that a relatively strong quantity of mercury can cause the spectrum of another element to disappear. But at all events our spectra show in a very convincing way the transmutation of lead into mercury..."

The researchers also conducted experiments with a nitrogen atmosphere at various pressures and a liquid dielectric (carbon disulfide) with 100Kv at 2 milliamperes for 12 hours. The mercury was chemically detected as the iodide. Similar results were obtained with 160 Kv at 10-20 milliamps. In six such experiments, 0.1-0.2 milligrams of mercury was recovered. The researchers suspected that the CS_2 had contained a trace of some organic mercury compound. However, positive results were still obtained even after it had been thoroughly purified.

Smits offered this explanation for the transmutations:

"In the case of the transmutation of lead into mercury, the inactive isotopes having the atomic weights 206, 208 and 210, we may assume, for example, that the isotope 206 suffers a transmutation giving an isotope of mercury:

$$Pb - \alpha = Hg$$
$$201 - 4 = 202$$
$$82 - 2 = 80$$

"But we may also assume that the other isotopes 208 and 210 undergo a transmutation. In that case we obtain:

$$Pb - 2\alpha - 2\theta = Hg$$
$$208 - 4 = 202$$
$$82 - 2 = 80, \text{ and:}$$
$$Pb - 2\alpha - 2\theta = Hg$$
$$208 - 8 = 200$$
$$82 - 4 + 2 = 80$$

In the case of the transmutation of lead into thallium we can assume, for example, the following process:

$$Pb - \alpha - \theta = Tl$$
$$208 - 4 = 204$$
$$82 - 2 + 1 = 81$$

"We see that of the different transmutation possibilities, [the first] is most simple. Moreover, I suspected this process could be expected first, as lead is the end-product of the spontaneous radioactive transformations... The best method of learning the nature of the transmutation is to examine spectroscopically whether the process is accompanied by the formation of helium or hydrogen, and to determine the atomic weights of the heavier products...

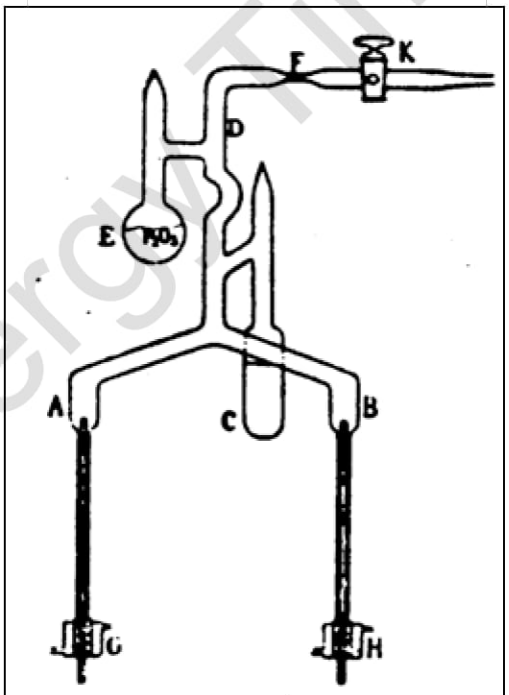

Fig. 1

"While using the old quartz-lead lamp, negative results were obtained only if the current strength was lower than 15 amperes, but now, with our new lamps... spectroscopically negative results were found even using 60 amperes. The lamp showed distinctly different properties in burning and sparking. This proves that the phenomena taking place in the quartz-lead lamp depend on influences unknown until now, so that transmutation in the quartz-lead lamp is not so easy to reproduce as we expected."

In 1926, A.C. Davies and Frank Horton reported that they had been unsuccessful in their attempts to replicate the Smits-Karssen experiments. They speculated that, "in the case of the transmutation of lead (82) into mercury (80), the change may occur either by the intermediate production of thallium by one of the processes already suggested [viz., "the entry of an electron into, or by the removal of a proton from, the nucleus of the mercury atom."], and the subsequent conversion of the thallium into mercury by a second similar process, or it can occur as a one-stage change by the ejection from the lead nucleus of either one doubly charged positive particle (presumably an α-particle) or two singly charged positive particles (presumably protons) simultaneously. If the process occurs by the intermediate production of thallium, one would expect to find evidence of a relatively large amount of thallium compared with the amount of mercury produced. Prof. Smits does not seem to have found such an effect, for he records stronger evidence of the production of mercury than of the production of thallium...

"When atoms are bombarded by electrons, it is possible that in a few instances an electron penetrates within the K shell of extra-nuclear electrons, though it is certainly surprising that this is possible in the circumstances of these experiments. When such a penetration does occur, the electron will be attracted towards the nucleus and may possibly be absorbed by it. Even so, in some cases the absorption of an electron by the nucleus may render the latter unstable and disruption may occur with the ejection of a proton and an electron, either separately or together, in which case the final chemical state of the disturbed atom will be the same as if the electron had been absorbed by the nucleus and a stable condition attained."

For some unknown reason, these explorations were not continued, and the issue disappeared from the scientific literature after 1928. This line of research remains open to exploration, since the questions it raised remain unanswered to this day.

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Lord Rayleigh's Experiments with Active Nitrogen

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In the 1930s and 40s, Lord Rayleigh reported to the Royal Society of London about his experiments with active (electrically excited) nitrogen and other gases. In 1940, he gave an account of his discovery of the anomalous energy released by active nitrogen at reduced pressure. As he explained in the abstract of his second paper published on the subject in 1940, "The amount of energy collected from the gas was surprisingly large, and is difficult to reconcile with existing theories of the nature of active nitrogen. In some cases the energy was as high as 10 eV for every molecule of nitrogen that passed through the discharge. [Later research raised the energy level up to 223 eV/mol.] This quantity of energy can with difficulty be accounted for by dissociation, even if it occurred to the extent of 100%."

In addition, he showed that "pieces of sheet gold, copper, silver or platinum may be made red hot or even melted by exposing them to active nitrogen produced in a low-pressure discharge. The nitrogen gives up its energy to the metal, which remains unacted on... Gold was selected as the most active metal...." According to Rayleigh, "The energy radiated as after-glow under favourable conditions is only of the order of 10^{-3} of the energy collected by the metal." This extra energy was about 1,000 times the amount radiated by active nitrogen alone under the most favorable experimental conditions he devised.

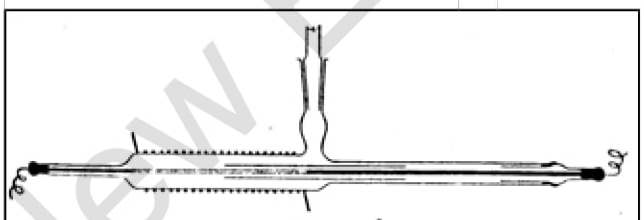

Figure 1.

"The after-glow consists chiefly of three heads of the first positive nitrogen bands. The maximum luminosity of the visual spectrum is at λ5550, and the wavelengths of the bands in question and their luminosities in terms of this maximum are as follows:

Colour	Wave-length	Luminosity
Green	5371	0.930
Yellow	5802	0.870
Red	6251	0.321

"The question may be raised whether the α system of bands have great energy in the infrared... We may fairly infer [based on the work of Kichlu and Acharya (1929)] that the infra-red contribution is not important."

Rayleigh calculated the "theoretical maximum for integrated nitrogen after-glow" to be 4.82 x 10^2 candle-sec., and used this number as a standard datum for his studies. He noted that, "Although the luminosity in the bulb remains visible for hours, its equivalent duration at the initial intensity is only about 3 seconds. The prolonged faint luminosity contributes very little to the total."

Lord Rayleigh also studied the effects of increasing and reducing the concentration of nitrogen, injecting active nitrogen into inert nitrogen, temperature change, other gases and metals, and the "wall-effect."

In 1946, Rayleigh published a sequel study on: "The surprising amount of energy which can be collected from gases after the electric discharge has passed." In the abstract of the article, he stated, "A new form of experiment is now described... in which... a platinum strip is kept hot by periodic discharges... [B]y making the experiment (1) with the Pt exposed to the gas and (2) with the Pt protected by a thin glass sheath it is possible to determine what part of the total energy is to be attributed to catalytic action of the discharge products. This amount of energy was found to be very great. Reckoning in electron volts per molecule of gas present it increased rapidly as the gas pressure was lowered and at the lowest pressure used it rose as high as 223 eV/mol. Results of the same order were obtained with other gases, so it is not clear that the glow of active nitrogen is the essential condition. This great liberation of energy much exceeds what can be explained by dissociation of the molecules and single ionization of every atom which results, which would only afford 36 eV." (Figure 1)

"To produce the electrodeless discharges, the same oil condensor was used as in my previous work. It was charged with an induction coil with a slow mercury break... An ebonite wheel with a conducting segment is mounted on an axle which is inclined at 45° to the horizontal. This wheel is immersed in Hg and makes and breaks contact once a revolution. The Hg is covered with a layer of alcohol...

"Along the axis [of the discharge vessel] there is stretched a Pt strip, over which a glass sheath can be slipped. The Pt can be heated by a current from a battery, and the tube is wound with a wire coil, which is used to excite the electrodeless discharge. When the discharge passes, the Pt strip gets heated, and its resistance increases. This is attributed partly to the direct-heating action of the discharge, and partly to the action of the Pt strip in catalyzing the discharge products (ions and dissociated atoms?).

"During an experiment, the Pt strip is kept at an arbitrary but constant resistance of *R* ohms. For this purpose it is made one arm of a Wheatstone's bridge, and the current is adjusted to heat the strip until the given resistance is attained. The current (C_1 amp.) is measured. Then the glass sheath is slipped into position, so as to screen the wire from dissociation products. A larger current (C_2 amp.) must now be passed to restore the resistance to its standard value of *R* ohms. The energy given up to the Pt wire by the dissociation products is

$$(C_2^2 - C_1^2)\, Rt \text{ W-sec.},$$

when *t* is the time interval in seconds from one discharge to the next.

"This energy is derived from, and therefore is contained in, the gas volume *v* at pressure *p* cm. of Hg.

"Thus the energy per unit volume reckoned as at atmospheric pressure is

$$\frac{(C_2^2 - C_1^2) Rt \times 76}{vp} \text{ W-sec./cc.}$$

"In a typical experiment, when the conditions were adjusted to get the best effect at the chosen pressure, C_1 = 0.78 amp., C_2 = 1.73 amp., *R* = 0.470 ohm, *t* = 0.25 sec., *v* = 19 cc., *p* = 2.6 x 10^{-3} cm. Hg. In this case the energy is 432 W-sec./cc. as at N.T.P., or 98.5 eV/mol. of N present."

Rayleigh calculated that the probable length of travel of the molecules of nitrogen, from the point where they received energy to central strip where they gave it up, to be about 1 cm. (the radius of the discharge vessel).

"The duration of the discharge (several oscillations) was estimated... and found to be 3.76 x 10^{-6} sec.. This requires the molecule considered to have a velocity of... 5

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x 10^5 cm./sec.. Now the molecular velocity of nitrogen is 5 x 10^4 cm./sec. at 273 K. To raise it 10 times, the absolute temperature must be increased 100 times, i.e. to the temperature of the hottest stars. It seems clear, therefore, that a molecule could not travel fast enough to give up energy to the Pt strip more than once during the short duration of a discharge. If not, it must carry 98.5 eV at one time and it is not easy to see how according to current ideas how it could do this. The energy of dissociation of nitrogen is 7.4 V, and this, together with the ionization of both the atoms, would only afford 7.4 + 2 x 14.5 V or 36 V. Considering that the discharge gives a band spectrum and not a line spectrum, the idea of complete dissociation and ionization is somewhat fantastic; but even if we make this assumption the difficulty remains.

"There appears to be no advantage in increasing the number of turns to the maximum, and close winding was inconvenient, because the coil showed a tendency to spark over. A coil having 26.5 turns was used in further experiments, as being about the useful maximum.

"The pressure was then varied, leaving the other conditions unaltered:

Pressure (cm.)	W-sec./cc.	eV mol. present
26 x 10^{-3}	5.32	2.16
12.4 x 10^{-3}	19.1	4.37
5.2 x 10^{-3}	92.3	21.1
2.6 x 10^{-3}	309	70.6
1.5 x 10^{-3}	643	147
1.1 x 10^{-3}	1020	233

"It appears, therefore, that the energy per molecule increases very greatly as the pressure is diminished.

"It was of interest to see whether these very large values of the energy per molecule are peculiar to nitrogen, or whether they would be found in other gases also. A few results only are available at present:

Gas	P, pressure (cm.)	W-sec./cc.	eV/mol.
Oxygen	2.6 x 10^{-3}	432	98.5
Hydrogen	4.3 x 10^{-3}	470	107
Nitrogen	2.6 x 10^{-3}	309	70.6

"These are of the same order of magnitude as the results for nitrogen, one of which is repeated for convenience of reference."

The high energy output of this relatively simple experiment suggests that a convenient source of "free energy" might be available therein. Aside from that notion, despite repeated reading of Rayleigh's articles on active nitrogen, this writer remains baffled as to how active N, O or H could possibly form Mass 5 as claimed by Ron Kovac (*Infinite Energy* #15/16, July-Nov. 1997 and elsewhere). Kovac does not explain the reaction pathway(s) involved, but perhaps I am missing something obvious.

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Jovivitsch's Transmutation of Carbon to Oxygen

Edited by **Robert Nelson**
(Rex Research, P.O. Box 19250
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In 1908, Milorad Z. Jovivitsch (Bergau-Akademie in Belgrad) published two unique articles in the journal *Monatschrift für Chemie*, describing, "The Mysterious Deficiency of Carbon in the Condensation Products from Ethylene and Acetylene."

Jovivitsch had been experimenting with electrical discharges in these gases, following the methods used by Berthelot. The latter had shown that the action of a silent electric discharge upon saturated or unsaturated hydrocarbons will split off hydrogen and produce condensation products.

Jovivitsch introduced pure dry ethylene or acetylene and oxygen into an ozonizer containing copper oxide, and electrified the mixture with 100 V/3 Amps for 3 days and 2 nights. His analysis of the resulting compounds showed a deficiency in the theoretical amount of carbon and hydrogen, and an excess of oxygen. Several determinations of the carbon and hydrogen taken together indicated a 7% deficiency in the ethylene reaction product, and a 22% deficiency in the case of acetylene.

Berthelot had accounted for these losses by attributing them to oxygen absorption from the atmosphere. Jovivitsch excluded that possibility by employing pure gases, and he immediately preserved the products in hermetically sealed tubes. There was practically no possibility of absorbing any significant amount of atmospheric oxygen. He also determined that the condensed ethylene loses no carbon on exposure to air, and that the condensed acetylene remains unchanged after many weeks. Comparative analysis of the reaction products preserved in tubes and those exposed to air showed them to be in close agreement.

Jovivitsch attempted to explain the scientific riddle of this chemical anomaly by attributing it either to experimental error or the transformation of elements. Because he took great care and made very precise analyses, Jovivitsch was convinced that a transmutation had occurred. His opinion was reinforced by the fact that the condensation products were radioactive.

These simple experiments need to be replicated with modern analytical methods. ***[Editor's Note: Yes, indeed! If a radioactive product was generated here, this needs to be checked out, pronto!]***

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Excess Heat versus Transmutations

by David Moon 8 March 1997; appended, 3 September 1997

Drs. Robert T. Bush and Robert D. Eagleton of California State Polytechnic University in Pomona appear to have taken the lead in suggesting the role of neutrinos as "likely accomplices in the energy-disappearing act [the shortage of excess heat]" during metal transmutations occurring in both light and heavy hydrogen cold fusion cells in some experiments[1].

Neutrino emissions during some kinds of nuclear transmutations were attendant within reaction schemes offered in the author's theoretical model of cold fusion named "Mechanisms of a Disobedient Science"[2]. The model conceives of the formation of long chains of deuterons (or protons) in the surface layers of the host lattice. In active electrodes, the chains were viewed to oscillate collectively against metal atoms, invading into the volume of a metal atom to a greater or lesser extent. At different regions within a metal atom's volume, called "windows", various cold fusion reactions were proposed--collectively giving a "spectrum of reactions".

A type of intermediate neutron was postulated to form in window II (in Pd or Ni, the inner electron cloud) when the invading proton or deuteron weakly captured an orbital electron, forming an "unstable mononeutron" (UMN,n^*) or "unstable dineutron" (UDN,$^2n^*$), respectively. These proposed neutral particles are convenient for carrying out several kinds of transmutations and fusions.

For example, in cells employing Ni-H_2O electrolysis in potassium carbonate electrolyte (e.g. R. Bush, R. Notoya), typical reactions that were proposed [2] are:

$$\text{(a)}\quad {}^{39}_{19}K + n^* \rightarrow {}^{40}_{20}Ca + e^- + \text{neutrino} \qquad Q=8.3\,\text{MeV}$$

$$\text{(b)}\quad {}^{62}_{28}Ni + n^* \rightarrow {}^{63}_{29}Cu + e^- + \text{neutrino} \qquad Q=6.1\,\text{MeV}$$

where e^- = beta particle

In this earlier article it was assumed that if transmutations such as calcium production actually correlated with the excess heat, then the fusion energy (Q) was going almost entirely to the electron in the emitted electron-neutrino pair. Negligible energy was thought to be carried by the neutrino.

However, in view of a more recent report by Prof. George H. Miley [3,4] of seeing occasionally very large amounts of metal transmutations in Patterson-type Ni-coated beads during electrolysis of H_2O--but with little excess heat to match--it may be plausible to conclude that in transmutations employing the UMN, such as reaction (b) above, that the leaving neutrino carries most of the Q-value out of the cell, while the beta particle (e^-) gets less energy--perhaps KeV instead of MeV amounts.

Therefore, it becomes necessary to predict that many metal transmutations involving UMNs are nearly energetically static, allowing their released nuclear energy to escape the cell via neutrinos.

In deuterium systems, however, it is still possible to generate highly energetic electrons with little neutrino loss. The cell retains most of the Q-value. A sample reaction with UDNs is:

$$\text{(c)}\quad {}^{108}Pd + {}^2n^* \rightarrow {}^{109}Pd + e^- + p + \text{neutrino} \qquad Q=3.9\,\text{MeV}$$

In reaction (c) and in similar reactions where the UDN ($^2n^*$) adds one neutron to the metal nucleus, the hypothetical mechanism is viewed to transfer the release of the mass-energy ($Q=\Delta mc^2$) to the ejecting neutron, n^* (where $^2n^*$ becomes $n\ldots n^*\rightarrow$). The mass of n^* initially picks up the departing momentum. The energy immediately transfers internally through the n^* structure to cause emission of the electron-neutrino pair, with the proton lagging behind. The electron is accelerated at probably MeV energy. The neutrino gets the leftovers.

For fusions involving the UMN (n^*) in light hydrogen cells, Δmc^2 cannot transfer as efficiently through the n^* structure to eject a very fast electron because the proton is being *absorbed* by the metal nucleus, and so is not available to conduct energy "outward" to the electron being released from the n^* particle. As a consequence, the accompanying neutrino is required to pick up most of the nuclear energy that is released.

One consequence of the new interpretation of UMN-induced transmutations is that the electrons emitted have less kinetic energy to create X-ray fluorescence and bremsstrahlung activity in the layers of metal and surrounding electrolyte.

This expected lower but still significant X-ray signal in H-systems compared to D-systems is consistent with findings reported in China [5] where, in electrical discharge experiments using niobium electrodes, "the energy and intensity of the X-rays for the Nb-D system was higher than that for a Nb-H system."

Cold Fission in NiH?

Evidence from experiments by Prof. Miley[3] on Ni-coated Patterson-style beads in H_20 electrolysis is very convincing that some of the host lattice atoms can undergo cold fission in layers just below the surface of the thin-film (<2000 Ångstroms) nickel. In fact, an entire grocery-bag-full of elements shows up in the post-run data.

More than one mechanism is likely needed to account for the multiplicity of effects in cold fusion and transmutation experiments. In this theory, UMN-induced fissions will be expected to operate in a similar way as the UMN-induced element shifts already discussed, and lose most of the fission energy to the outside via neutrinos.

But to make the fission of a nickel isotope energetically lawful (+Q), two UMNs generally will be required to invade the same Ni nucleus at nearly the same time. Perhaps at certain depths just below the surface a few layers of proton chains concentrate. An increased flux of UMNs that forms might focus or collect on a lattice site (possibly near a lattice void or defect) giving a chance for concurrent absorption of a second UMN by a single nucleus. Thus, the nucleus experiences "double excitation" and fissions with the energy being distributed mostly to the neutrinos, leaving low-energy fission fragments which do not give significant excess heat. A sample proposed reaction is:

$$\text{(d)}\quad {}^{58}_{28}Ni + 2n^* \rightarrow {}^{32}_{16}S + {}^{26}_{14}Si + 2(\ldots)e + \text{neutrino} \qquad Q=1.9\,\text{MeV}$$

Window I: More Sun

For all cold fusion methods using either hydrogen or deuterium, the primary source of excess heat has been the various fusion reactions involving the p or d chains

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in window I (the metal atom's electron cloud), [2]. Proton chains invading into window I can produce high levels of excess heat while nearly missing the UMN- or UDN-catalyzed transmutations and isotope shifts in window II, or vice versa.

Thus, for example, in Ni-H_2O electrolysis, proton fusion inside a metal atom's electron cloud gives most of the excess heat—which is probably not correlated with transmutations , but can be consistent with them—as some active cells could see comparable levels of window I and window II activity. But when window II dominates, heat falls short of transmutations.

Proton fusion in window I also requires neutrino emission:

$$\text{(e)}\quad p + e^- + p \rightarrow d + \text{neutrino} + 1.442\ \text{MeV}$$

However, it was previously suggested that the largest quanta of the energy released are spread throughout coherent domains of the lattice by means of phonon vibrations.

Lines and Slopes

A most revealing discovery following H_2 gas-phase experiments in Italy using Ni rod with solenoid winding (the Piantelli patented device [6]) was communicated to this author by WJMF Collis (Asti, Italy),[7]: "Regarding parallel etches on the nickel surface, you may be interested to know that these appear to form spontaneously in 'working' nickel samples…I believe there may be a correlation between the dimensions and orientation of the furrows and the external applied magnetic field."

Indeed! Evidence from the Piantelli group strongly suggests that at least some of the fusion energy can be carried along the proton chains, creating linear "burns" in the electrode surface. Keen use of a magnetic flux can optimize the creation of proton (or deuteron) chains.

An even better approach might be to use perpendicular solenoids around an electrode cylinder containing powdered or granular metal in H_2 gas. Then the "magnetic cage" could perhaps motivate a "swirling vortex" of proton chains to form on the metal grains. Chuck Bennett (Sacramento, CA) has emphasized the need to consider the formation of nano-sized bubbles containing plasma vortices [8,9] and the "hot spot" theory of Dr. Roman Sioda (Warsaw, Poland),[10].

The historic Second International Low Energy Nuclear Reactions Conference (ILENR2) near Texas A & M University (Sept. 1996) included a presentation by Dr. Mitchell Swartz. In his review of Dr. Swartz's paper, Jed Rothwell noted a peculiar finding [4]: "Swartz describes what he calls the 'pi-notch' graph of excess heat with Ni-H_2O. This has been noted by others, especially Mills, Thermacore and CETI. You get the most heat with low current density. As current increases, the heat peaks, and it declines as a percent of total input. With Pd, higher current density usually increases loading, which increases the heat geometrically. The cause of the Ni drop-off is a mystery."

For PdD electrodes, increasing the current density promotes increased surface loading—that is, the flux of oscillating (sloshing) deuteron chains that can invade into window I where most cell-heating fusions occur.

But the loading is more gradual as current density increases in palladium. This property is due, in part, to "the bulk depleting the surface" (lending wisdom to the use of thin-film Pd). Thus, the function of the excess heat with applied current describes a more gradual slope, and extends over a wider range of total input.

In the case of NiH electrodes, I understand nickel does not soak up hydrogen to great depths, so that as soon as the surface loading is accomplished and active sites exist, further step-up of current will pump energy into the proton chains. This means a larger fraction of the chains will invade into window II of the metal atoms where UMNs form, giving lower cell-heating transmutations. This results in a drop in excess heat with respect to current density. In general, lower input promotes window I (heat), while higher input promotes window II (and beyond), which gives less heat.

Evidence Erupting

Cold fusion experiments which use deuterium may be predicted to include some transmutations that suffer energy loss through neutrino emissions during reaction. For example:

$$\text{(f)}\quad {}^{102}_{46}Pd + 2n^* \rightarrow \left[{}^{104}_{47}Ag\right] + e^- + \text{neutrino}$$
$$\left[{}^{104}_{47}Ag\right] \rightarrow {}^{104}_{46}Pd + b^+ + \text{neutrino}\quad (66m)$$

In reaction (f) the pathway has allowed most of the energy to escape with the neutrino. Then the Ag-104 nucleus decays by positron emission to palladium-104. But if the excited Ag-104 nucleus should release a smaller quantum of energy to the electron-neutrino pair, then excitation energy remains in the nucleus to possibly cause fission, such as:

$$\text{(g)}\quad \left[{}^{104}_{47}Ag\right] \rightarrow {}^{90}_{40}Zr + {}^{14}_{7}N$$

Perhaps even trimodal fissions are possible. For example, the following typical fissions may help explain the many new elements measured by T. Matsumoto and K. Kurokawa (Hokkaido University, Japan) in Pd-D_2O electrolysis experiments [11]:

$$\text{(h)}\quad \left[{}^{104}_{47}Ag\right] \rightarrow {}^{65}_{29}Cu + {}^{34}_{16}S + {}^{4}_{2}He + {}^{1}_{0}n$$

$$\text{(i)}\quad \left[{}^{104}_{47}Ag\right] \rightarrow {}^{49}_{22}Ti + {}^{37}_{17}Cl + {}^{18}_{8}O$$

Copper, sulfur, titanium and chlorine are among the myriad of new elements found at the palladium surface by Matsumoto and Kurokawa. The authors state [11] that "as cold fusion proceeds, tiny spot defects grow into grain-shaped defects in which materials disappear by extraordinary burning…. that cold fusion has taken place violently near the surface of the palladium." The data seem to imply that a great variety of energetic cold fission reactions do occur at or near the Pd surface.

Unfortunately, reactions like (g), (h) and (i) are now expected to produce daughter nuclei with relatively low energy due to neutrino loss. Scanning electron microscope (SEM) pictures of spent (reacted) palladium cathodes by Dr. Matsumoto [11] show grain-shaped defects which are evidence of volcanic-like eruptions from just under the surface. At least 17 new elements including chromium, calcium and iron were detected at the ridges of the craters.

Although the authors attribute the crater formation to explosive cold fusion from below (a reasonable and probable hypothesis), some highly energetic fissions of palladium are also possible when quad-neutrons, which are occasionally formed inside the palladium atom's electron cloud during d+d fusion[2], are absorbed by the Pd nuclei. For example:

$$\text{(j)}\quad {}^{104}_{46}Pd + 4n \rightarrow {}^{48}_{20}Ca + {}^{60}_{28}Fe \quad Q = 19.5\ \text{MeV}$$

$$\text{(k)}\quad {}^{104}_{46}Pd + 4n \rightarrow 2\ {}^{54}_{23}V \xrightarrow{-\beta-\gamma} 2\ {}^{54}_{24}Cr \quad (55\ \text{sec})$$

This type of explosive fission, it seems, could throw nuclear debris from all the other transmutations onto the palladium surface.

Distinguished Professor of Chemistry John O'M. Bockris of Texas A&M University briefly reviewed findings by Russ George (E-Quest Sciences) in his report at ILENR2, Sept. 1996 [12]: "Helium-4 found in Pd electrodes irradiated with ultrasound. New elements found at edge of craters detected on surface." (See also Tom Benson's earlier review of E-Quest[13].)

So now we have craters on palladium besides craters on the Moon. No doubt, skeptics think the former is nothing more than "green cheese" (I beg your pardon!). However, it's too late. The evidence is already overwhelming. Researchers of the skill and integrity of Bockris, Miley, Mizuno, Matsumoto, Ohmori, Dash, Claytor and so many others (et al.2) make it absolute! The transmutation and excess heat results— although no longer correlated in "Mechanisms of a Disobedient Science"—are becoming more and more repeatable. More than "once in a Blue Moon."

Gold Fission

Finally, certain fissions which retain the Q-energy in light hydrogen cells (utilizing UMNs) can be postulated. Ohmori, Mizuno and Enyo found crater-like damage and new elements – along with excess heat – on gold cathodes electrolyzing light water, as reviewed in Infinite Energy by Jed Rothwell [4] and Ed Lewis [14]. One speculative reaction is:

$$\text{(l)}\quad {}^{197}_{79}Au + n^* \rightarrow {}^{190}_{75}Re + 2({}^{4}_{2}He) + 6.8\ \text{MeV}$$
$${}^{190}_{75}Re \rightarrow {}^{190}_{76}Os,\ \text{beta decay (2.8m)}$$

In his Ni-H_2O cells, Prof. Miley sees a large amount of iron[3]. A possible reaction to account for the popular iron-56 is:

$$\text{(m)}\quad {}^{58}_{28}Ni + 2n^* \rightarrow {}^{56}_{26}Fe + {}^{4}_{2}He,\quad Q = 12.6\ \text{MeV}$$

Perhaps helium-4 production is surprizingly common in light hydrogen cells – not just in deuterium –loaded electrodes. In fact, the direct formation of stable isotopes (e.g. Fe-56) in low-energy transmutations is favored by Dr. Heinrich Hora, et al. [15] who predicted several reactions (in proposed remediation of radioactive waste) that would split off alpha particles.

Conclusion

Jed Rothwell, reporting his impressions and speculations after the ILENR2 Conference, insightfully wrote [4]: "Perhaps someday we shall learn to 'tune' the reactions to produce concentrated excess heat or transmutations that produce rare and expensive elements."

The summary here is the same: To achieve excess heat, adjust the cell to window I; for transmutations, move to window II.

Will commercial and industrial cold fusion devices designed for either heat or element production soon be on the market?

Stay tuned!

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Another Piece of the Puzzle

by Graham Toquer

This is a follow-up to a follow-up to my first article ("Neutrino Power," *Infinite Energy* Volume 3, No. 13 & 14, p 106.) In No.15&16 (p.117) I commented on transmutation. Another piece of evidence in support of my theories has surfaced.

In my original article, I theorized that neutrinos inhabit an extra dimension which I called N-Space. A cold fusion device interacts with neutrinos by squeezing the electron shell of a hydrogen atom. The electron slips partly into N-Space and picks up energy from them.

I speculated on how this might affect solar dynamics and stellar evolution. Since hydrogen atoms are squeezed in the outer shells of stars, energy can pass into and out of N-Space. The sun only emits about a third as many neutrinos as theories predict. I believe that "Toquered" electrons are filtering out the rest.

Now in the early days of the universe, the first protostars would have interacted with N-Space as soon as they acquired enough mass. As I wrote in my original article:

If N-Space was originally cold and empty, stars would have lost a lot of energy into it at first. . . . When the temperature of N-Space reached the average stellar hydrogen core temperature, the loss would have stopped. Stars that were running a little cooler than average could gain energy. Stars that ran hot could lose it, creating a leveling effect.

Quite possibly, this moment of equilibrium was reached very abruptly through the universe. After all, N-Space is very small in volume by cosmic standards, and neutrinos may be tachyonic anyway. If so, suddenly every star in the cosmos was over-fueled for its spectral class. How much so is a function of the rate at which a star can gain energy from or lose energy to N-Space.

The wildest possibility is that many of the stars in the universe exploded, popping off like firecrackers in an incredibly short period of time by cosmic standards. . . .

Well, I just picked up the November 3, 1997 issue of *Newsweek* with the cover article about galaxies by Sharon Begley. It was mainly concerned with the new data brought in by the Hubble Space Telescope. According to Ms Begley:

The second surprise from the Deep Field is that the Universe's lights, contrary to astronomers' hunch, turned on in one great burst. It was as if every chandelier in a mansion were flicked on simultaneously on a moonless night. Today, only about two stars turn on in our Milky Way every year. Back then tens of thousands turned on every year. How could the lights go on practically at once?

I first published my theories in 1994 without getting a single response. The only person who has responded so far is Arthur C. Clarke. Clarke answered my letter in longhand and remembered my 1994 article! With an endorsement like that, it's time people started taking me seriously. There are a few very simple tests:

1. The energy emitted by a cold fusion experiment should increase if the working element is stimulated by radio waves, alternating current, or an oscillating magnetic field on the frequency that corresponds to the 21 centimeter wavelength (the hydrogen emission frequency.) This is roughly microwave oven frequency, so it will not be hard to rig up. However, see my original article concerning the dangers of feedback. There was a fatal explosion at SRI International some years back.

2. The radiation emitted by any radioactive substance should increase when it is bought near a working cold fusion experiment. (See previous follow-up.)

3. I speculated that the Toquer effect is involved with the phenomenon of superconductivity. If so, any superconducting material should become more so when brought near a working cold fusion experiment. Possibly, even the resistance of a normal electrical conductor will decrease. This is only a speculation, and I wouldn't bet on it myself. But it would be the easiest test to run, as all you would need would be a battery, a conductor, a load, and an Ohm meter or wheatstone bridge to measure resistance. Superconductors are a little harder to come by, but not impossible. ∞

"A Unity Engine": Further comment by Kenneth Rauen

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4 Jan 98

I want to expand the concepts of my new heat engine cycle. The cycle was referred to in the *IE* article "A Unity Engine" as a cold engine. I specifically name it the Rauen cycle engine, or RCE for short. There is another name for it, stripped of my name, but it will not be divulged yet because it clearly describes the engine. The RCE is not just one specific cycle, but a family of cycles composed of many different processes and working fluids, plus a series of corresponding heat pumps. The engines can be piston versions containing the entire cycle within one compact mechanism like a Stirling cycle engine, or turbine versions with discrete hardware for each step, piped together like electric utility Rankine cycle engines.

Though I said it is possible for some heat engines to exceed Carnot and under reversible conditions to be unity efficient, I meant more than that. For the first public claim of super-Carnot efficiency, this was enough. A more complete statement is that unity efficiency can be approached (on the order of 99.99%) under irreversible, common, every day conditions.

Since the Second Law is not a law of physics with a hard-and-fast principle behind it, but is merely a statement of collective experience about the flow of energy, new experience automatically extends the law from the practical point of view. The academic point of view already allows for the RCE as pointed out in "A Unity Engine."

It was mentioned in the *IE* article that the first mathematical proof raises a debate about the definition of a working fluid. This needs elaboration. One of the processes in this engine example has a fluid which is used only for heat transfer. Unfortunately, if its temperature is included in the Carnot efficiency calculation, the engine does not exceed Carnot. I do not include this temperature in the Carnot calculation because this heat transfer fluid does no work nor has any work done on it. Carnot's argument deals only with the working fluid. Does a thermodynamicist include the temperature of the combustion flame in a fossil fueled boiler when calculating that Rankine steam engine's Carnot efficiency? No! Only the temperatures of the steam, the working fluid, are used. The combustion flame is a heat transfer fluid, but not a working fluid. Yet a radiant heat boiler won't work without that combustion fluid's exceedingly high temperature. Just because an engine needs a particular set of conditions to operate does not mean all conditions contribute to the theoretical calculation of efficiency. The fuel pellets in the core of a nuclear fission power plant have a higher temperature than the steam that cools them, the uranium pellet temperature is not included in the thermal efficiency calculation. Why should my engine cycle have to include a necessary but unrelated temperature in the Carnot calculation? Could carelessness or hubris be operative among scientists? My mathematical proof's only utility is to show hard data that Carnot is no longer a limit. For a given heat source temperature and heat sink temperature, more efficient engines are available than this version of the RCE found in the proof. This proof is not given

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as a practical engine nor as a limit of the Rauen cycle. The desired embodiments of the RCE have processes that only contain fluids that are working fluids and therefore do not have questionable Carnot temperatures. The second proof overcomes this argument. The processes of the first proof were selected only for their fully documented state variables of temperature, pressure, volume, enthalpy, and entropy at every point in the cycle.

The second proof is closer to the practical engine I envision. Despite being a good proof, this version of the RCE also has a limitation. The limitation is the necessary rejection of some heat in the practical engine (the theoretical engine is still unity), so it is not possible to demonstrate 100% efficiency in this embodiment of the RCE. Though it surpasses the maximum efficiency defined by Carnot, this higher efficiency is not enough by itself to produce work from environmental heat. Unity efficiency is required.

The way to tap ambient heat with a super-Carrot engine that is not unity efficient is to combine it with a heat pump to recycle all of the rejected heat and still have a net output of work. The second proof RCE which is 70% efficient can be combined with a commercially available, Carnot limited, reverse Rankine cycle heat pump (the compressor variety in nearly all refrigerators and air conditioners) with a realistic coefficient of performance (COP) of 2.5:1 for a net output of work. 30% rejected heat divided by 2.5 is a heat pump work load of 12%, reducing the work output from 70% to 58% of the energy transferred each cycle. The overall efficiency is 100%, since 42% is recycled and therefore only 58% is added by the heat input to balance the energy flow by the First Law of Thermodynamics. 58% work divided by 58% input is 100% efficiency. Internal efficiency is 58% and external efficiency is 100%. Environmental heat can be converted to work not only by unity engines, which makes intuitive sense by their lack of waste heat, but also by heat engines that just barely exceed Carnot and are combined with a sub-Carrot heat pump. Whether Carnot is only exceeded or whether unity is also achieved is unimportant. Either one will solve our energy needs. It is just that one will be more practical than the other.

Let's take a closer look at how significant the effect is upon overall efficiency when a sub-Carrot heat pump assists a super-Carnot engine. The RCE in the second proof operates with a temperature differential of about 100 degrees Fahrenheit above room temperature. Room temperature is about 270 degrees Kelvin. The upper temperature is about 320K. The Carnot efficiency of the engine is (320 K-270 K)/320 K = 16%. The Carnot efficiency of a heat pump operating over the same temperatures is 270K/(320K-270 K) = 5.4:1 COP. If the super-Carrot engine is 25% efficient and the sub-Carnot heat pump is 4:1 COP, the combination is at the break even point; its net work output is zero while the contraption idles on the brink of stalling. At 25% and 4.5: 1, the result is 100% external efficiency and 25%- (75%/4.5:1) = 8% internal efficiency. For every watt of work it produces, it cycles 12.5 watts of thermal power within the combined cycle of heat pump and engine. 11.5 watts is recycled power. Above the break-even point, efficiency jumps to unity but the power varies. A super-Carnot heat pump can likewise assist a sub-Carrot heat engine. These examples are analogous to the Gibbs Free Energy (GFE) processes which recycle the heat and entropy losses of an expansion process, which is the RCE.

It was stated in the *IE* article that the essential difference between GFE and thermal energy is fixed versus variable energy transitions. There is another essential difference. Spontaneous thermal energy transformations can only produce entropy increases, but spontaneous GFE transformations can also produce entropy decreases. This is key to understanding the profound effects produced in a heat engine by nonthermal processes. It cannot be overstated that GFE controlled phenomena can recover the entropy losses of thermal phenomena without causing an engine cycle excessive energy penalties. If a sub-Carnot heat pump plagued by entropy inefficiencies can greatly increase the efficiency of a marginally super-Carnot engine up to unity, imagine how easily entropy decreasing GFE processes can do the same to an engine with a sub-Carrot, classical expansion process.

An RCE that is 100% efficient will always remain 100% efficient. As a classical engine deteriorates, power and efficiency decrease. (This time frame is well beyond what constitutes steady state operation; of course, steady state operation takes place in classical heat engines.) A unity RCE will only lose power with age. Efficiency will remain at 100% until power drops to zero.

The unity RCE converts all heat to another form of energy, though not all heat is converted to work. I hope this subtle distinction is clear. Isn't it amazing that all heat is converted? Could it be unbelievable that all heat is converted? Think of the real world performance of all heat pumps, refrigerators, and air conditioners. They all create an internal heat sink to which heat flows from the environment. These heat sinks do not deteriorate; all heat is lifted in temperature from these heat sinks on a steady state basis. If they did not, these heat sinks would dwindle as predicted by the Second Law and get warmer from an accumulation of unconverted heat, or else the COP would decrease, requiring more input energy to lift the same heat. By experience, we all know this does not happen, that steady state operation is normal. So as I say, the total conversion of ambient heat to another state is possible. In the sense of being able to do a complete conversion of heat in a process to other forms, a heat pump has "100% efficiency" or perfect performance in capturing heat, although the heat input to run the heat pump is higher than theoretically perfect, decreasing the COP, evidencing the demands of the Second Law. Looking at just a portion of a heat pump's cycle as 100% is a fair comparison to the unity RCE because I am demonstrating with a reality familiar to all people the same physical phenomenon claimed to be present in the RCE, that all heat flowing into the environmentally heated engine is converted from its original state in steady state operation.

On a different subject, I have some observations on low energy nuclear transmutations to share with the readership. There is a direct parallel between the development of electronic semiconductors and nuclear processes. The vacuum tube was developed in the early 1900's. It is understood through plasma physics. The transistor was invented in 1947. The transistor does not behave according to plasma physics; it conforms to solid state physics. Though it did not happen during the development of the transistor, vacuum tube engineers could have said, "The transistor is a mistake. You made errors in your thinking and in your measurements. Plasma physics says it cannot do what you claim it can do. It cannot operate at room temperature; the electrons won't flow freely enough at that temperature. You cannot gate electrons with only half a volt, it must be 50 volts or more. Where is the high voltage? Where is the high power dissipation? Your claim that it conducts not only electrons but also 'electron holes' is ludicrous! You are off your rocker! Vacuum tubes only conduct in one direction and you claim some transistors can conduct in both directions? You can't possibly have a semiconductor here!" Does this sound familiar?

Here are some other thoughts. Nuclear scientists may scoff at radioactive remediation because it happens under mild conditions and it accelerates the rate of decay. Doesn't this also describe a fission power reactor? As for rapid rate of decay, how about the atomic bomb? Once again, could carelessness or hubris be operative among scientists?

Yours In Pursuit of Truth,
Ken Rauen

Editor's Note:

We wish to thank Ken for another *most intriguing* contribution. In his "Unity Engine" piece in *IE*#15/16, a production error on our part inadvertently cut off his final reference. The reference was:

6. Mark Goldes, Magnetic Power, Inc. 301A North Main St., Sebastopol, CA 95473 — (Phone: 707-829-939)

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Now in our Third year, ***INFINITE ENERGY*** magazine premiered with the March/April 1995 issue, which was distributed to the participants of the Fifth International Conference on Cold Fusion (ICCF5), held in Monte Carlo, Monaco (April 1995). The May/June 1995 issue was sent to many hundreds of current subscribers, journalists, and libraries. In 1997 we passed the 1,500 subscribers mark and now have subscribers in over **three-dozen countries.** The magazine now has limited distribution on select U.S. newsstands and is expected to expand greatly, now that commercial applications are emerging . *IE* is presently subscription-driven through ads in international magazines. Typical 1996/1997 press run: 5,000 copies/issue. **[WWW site— http://www.infinite-energy.com]**

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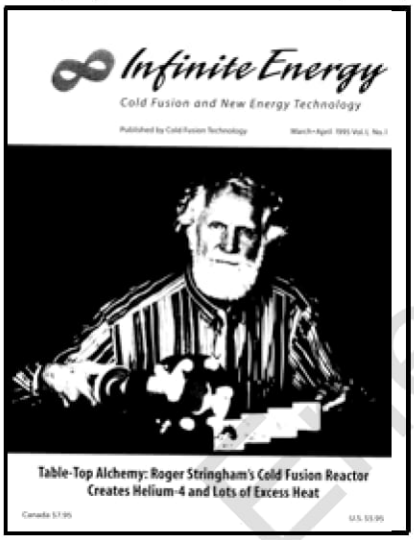

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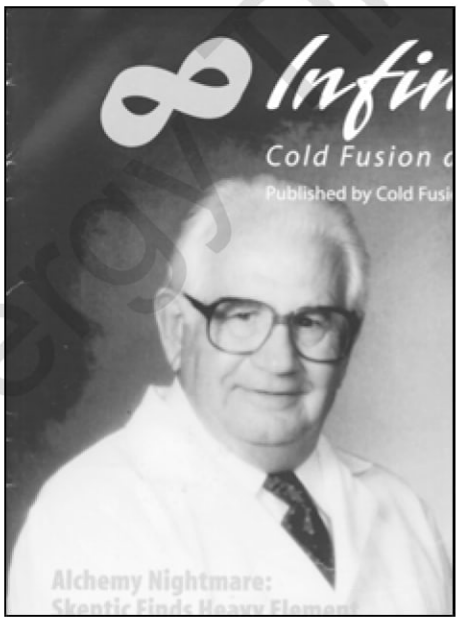

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